# ENGINEERING NEWS
AND
## AMERICAN RAILWAY JOURNAL.

**Vol. XLVII. No. 26.**


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THE PANAMA ROUTE FOR AN ISTHMIAN CANAL, or what is known as the Spooner Isthmian Canal bill, was passed upon by the U. S. Senate on June 19 by a vote of 67 to 6. This bill provides for the construction of a canal by way of the Isthmus of Panama, provided that a good title can be obtained from the French company; otherwise, the Nicaragua route is to be selected. An amendment to the bill was passed authorizing the issue of $130,000,000 2% bonds to be sold at not less than par. The House bill which was passed some time ago, specified the Nicaragua route only. Though this latter bill was passed before the Panama company had made its offer and the Isthmian Canal Commission had reported favorably on the physical conditions at Panama, a lively conference will take place between the Senate and House.

INSULATED JOINTS to prevent electrolysis of gas mains have been inserted on the high-pressure gas main of the North Shore Gas Co., of Waukegan, Ill. The main in question parallels a trolley line for 13 miles, and tests showed that the pipe line was returning about 25% of the entire current to the power houses, which are about ten miles apart. The pipe line has a rubber-packed Dresser expansion joint every 1,200 ft. It was thought that 90% of these joints entirely broke the conductivity of the pipe, but this was deemed insufficient. The pipe was therefore cut in two places and a break of 10 ft. secured by inserting insulating couplings with rubber packing. Such joints, as nearly as could be determined under the fluctuating current, diminished the return current through the pipe by from 50 to 75%. The account of these joints as here given was taken from a paper on "Electrolysis of Underground Metals," read before the recent annual meeting of the Western Gas Association by Mr. Edwin J. Humiston, of Chicago. The North Shore Gas Co. supplies Waukegan, North Chicago, Lake Bluff, Lake Forest, Fort Sheridan and Highland Park, Ill., and Mr. G. F. Goodnow, of Waukegan, is manager of the company.

WATER PURIFICATION STUDIES at Harrisburg, Pa., are to be made as a preliminary to designing the new filter plant for that city. Mr. James H. Fuertes, M. Am. Soc. C. E., of New York is consulting engineer in charge of water supply and other improvements at Harrisburg. The studies mentioned will be made under his direction and with the assistance of Mr. Chas. Gilman Hyde, who, for two years has been connected with similar studies at Philadelphia. The Harrisburg work will include analyses of water directly from the river and from the city reservoir; also from experimental filters. A laboratory will be established.

THE EXAMINATION TO FILL VACANCIES in the Corps of Civil Engineers, U. S. N., announced in our issue of May 1, was held at Washington on May 26, and was attended by 19 candidates. Two of these attained the required percentage and will be commissioned with the rank of lieutenant, junior grade, by the President within a few days. They are Mr. Chas. A. Wentworth, of Somerville, Mass., a graduate of the Massachusetts Institute of Technology, and assistant engineer with the Boston Bridge Works; and Mr. Geo. A. McKay, of Troy, N. Y., a graduate of the Rensselaer Polytechnic Institute, and at present inspector in charge of the construction of the Government coaling plant at Narragansett Bay. While the remaining candidates did not attain a percentage that would make them eligible for commissions, the Navy Department has decided that the showing made by all of them is sufficiently creditable to make them eligible for civilian appointments at the different navy yards, which do not require nomination by the Civil Service Commission. Congress having incorporated in the naval appropriation bill a provision for additional appointments to the Corps of Civil Engineers, U. S. N., at the rate of three per year for the next four years, three appointments can be made next month, and three more after the first of January next, if the bill passes in its present form. These six vacancies will be filled by a competitive examination to be held about Oct. 1st. Application to take this examination should be made to the Secretary of the Navy, if the law is enacted. Rules governing the examination and a set of examination papers were published in our issue of May 1. The matter of holding the coming examination simultaneously in a number of large cities, such as New York, Chicago, etc., is being favorably considered, and it is not improbable that this will be done wherever the number of applications from any locality makes it desirable.

CIVIL SERVICE EXAMINATIONS will be held at Washington, D. C., by the U. S. Civil Service Commission as follows: July 8, 9, 10, for deck officer in Coast and Geodetic Survey, age limit, 18 to 25 years; July 10, three laboratory assistants in National Bureau of Standards, salaries, $900, $1,000 and $1,400, minimum age limit, 20 years; July 15, assistant in the road material laboratory, Bureau of Chemistry, Department of Agriculture, minimum age limit, 20 years.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a collision between passenger trains that is reported to have occurred on the Northern Pacific Ry., near Staples, Minn., on June 20. It is said eight persons were killed, at least four of them passengers, and about the same number of others injured.——A passenger train on the Chicago, St. Paul, Minneapolis & Omaha Ry. was derailed on June 22 near Ashton, Ia. Two men were killed, both of the train crew, and several others injured. The train was running at high speed at the time of the accident; it is thought a misplaced switch was the cause of the wreck.

THE COLLAPSE OF A RAILWAY TRESTLE, near Shelby, on the South Carolina & Georgia Extension R. R., on June 19, dropped four freight cars and one passenger car 75 ft. The trestle was 250 ft. long and the engineer, Dank Albert, by pulling the throttle wide open saved his engine and all but the five cars. One man was killed and 9 men were seriously injured; two fatally.

A SMALL WATER TANK COLLAPSED at North Attleboro, Mass., on June 18. It had just been built to give additional fire protection to the factory of Riley, French & Heffron. It had a capacity of 15,000 gallons and was about 60 ft. above the ground.

THE MASONRY DAM THAT PARTLY FAILED on the outlet to Squam Lakes, near Ashland, N. H., on June 8, was about 14 ft. high and 70 ft. long, and was built in 1874. High water appears to have undermined a portion of one of the wing walls of the structure. We are indebted to Mr. Jas. A. Nichols, of the International Paper Co., Ashland, N. H., for the information given.

AN ELECTRIC PILE DRIVER AND DERRICK have been used by Roemheld & Gallery, of Chicago, in the construction of the 95th St. bascule bridge over the Calumet River (Eng. News, Jan. 10, 1901). The pile driver has 30 ft. leaders and a 1,000-lb. hammer, and is operated by a 10-HP. motor. This machine was used for driving about 2,000 lin. ft. of sheet piling, the piles being of the Wakefield triple-lap pattern, 6 x 10 ins., 22 ft. long. The machine had to travel considerable distances over uneven ground, but did its work perfectly. The derrick has a 65-ft. boom, 40 ft. mast and two stiff-legs. It is operated by a double-drum hoisting rig, with gear connected to a 25-HP. motor. The hoisting drums are controlled by the ordinary friction clutch and brake. This derrick has lifted 14 tons as its maximum load. A similar derrick, but operated by steam, is used on the opposite side of the river, but the electric derrick is found to be much more economical, convenient and efficient, particularly on this class of work, where its use is intermittent. On the same work an 18-HP. motor is used to drive two centrifugal pumps with 6-in. and 8-in. suctions. They were operated by means of a jack shaft, so that either one or both could be used. For pumping large quantities both pumps were run simultaneously, while for handling seepage the smaller pump only was used. The maximum lift of water was 35 ft. Current was obtained from the electric railway wires. An electric pile driver for ordinary piling in trestle construction is part of the equipment of the electric interurban railway system of the Union Traction Co. of Indiana. This is a double-truck flat car, with 18-ft. leaders, and giving a reach of 16 ft., for the construction of trestles with bents 16 ft. apart. The hoist is operated by a 35-HP. street car motor. This machine was devised by Mr. Bloss, the Chief Engineer, and Mr. Watson, the Master Mechanic of the road.

THE STRAIT OF CANSO BRIDGE, says a newspaper item from Sydney, C. B., is to be commenced at once under J. A. L. Waddell, M. Am. Soc. C. E., as Chief Engineer. The plan proposed is a double-track cantilever bridge, with a span of 1,800 ft. and a clearance of 58 ft. above high water. The line of the bridge extends from Port Hastings, on the Cape Breton side, to Cape Porcupine, Nova Scotia, a distance of 2,800 ft. The two shore piers are to be sunk in 90 ft. of water.

TO ADAPT THEM TO BURNING COKE, the Boston & Maine R. R. Co. is changing the firebox on 50 of its locomotives this summer, and expect to have 100 changed by January next. President Lucius A. Tuttle says that it costs about $50 to change a locomotive by deepening the firebox and placing water grates, and by building up the tenders they can carry coke enough to run the engine 125 to 150 miles without refueling, or as far as they can run with coal. The advantages of coke are that it is dustless and smokeless, costs about the same as bituminous coal, and it only requires refiring about every 12 miles, instead of constant firing, as with bituminous coal.

THE DEVELOPMENT OF THE LONDON DOCKS is recommended by a royal commission appointed to investigate conditions. This commission favors the reorganization of the port of London; a sweeping reform in dock management; a single dock authority; that warehouses be sold or leased; the expenditure of $22,500,000 in ten years in developing dock accommodations; and the spending of $12,500,000 in widening to 600 and 1,000 ft. and deepening to 30 ft. the channel from the Nore to Albert Dock.

50-TON ANCHOR CHAINS, for the Pacific steamers being built for the Great Northern Steamship Co., have been made at the Lebanon Chain Works, Lebanon, Pa. Each link weighs 165 lbs.; and the chain is divided by swivel-shackles into 90 or 180-ft. lengths; to each steamship will be delivered two chains of 990 ft. each. This chain has been tested up to 549,000 lbs. to the sq. in., on the 600,000 lb. strain testing machine at the works.

U. S. EXPORTS TO ASIA this year show greater gains than to other parts of the world, says the U. S. Bureau of Statistics. To the Dutch East Indies, in the ten months ending with April, the gain over the same period last year is as $1,683,186 is to $1,491,142; to Hongkong, as $7,396,270 is to $6,935,703; to Japan, as $18,981,250 is to $15,118,532; to China, as $20,163,123 is to $7,423,343. Our exports to China in 1892 only amounted to $5,663,497; they will probably reach $25,000,000 this year. And to Japan in 1892 we exported goods to the value of $3,290,111, while they will reach $23,000,000 this year. In 1892 we exported goods worth $3,674,307 to the British East Indies; this year the value will reach $5,000,000. To all of Asia in 1892 we sent goods valued at $19,590,350; in 1902 these exports will aggregate in value $66,000,000.

THE SOFT-COAL BURNING NUISANCE in New York is making trouble for the elevated railway system. In answer to the request of District-Attorney Jerome, the officials of the Manhattan Railway Co. say that they cannot obtain hard coal of the character required, and that they must burn soft coal to keep the road in operation. When the strike in the anthracite region was declared the company had about 20,000 tons of coal on hand; but this supply has now diminished to about 1,000 tons. Lately soft coal had been used exclusively in the locomotives, except in those running on the 34th and 42d St. spurs in Third Ave., where hard coal was used out of consideration for the hospitals, hotels and apartment houses situated there. President Skitt said that it was a case of necessity not of choice, as soft coal injured the fireboxes; but the orders were to stoke the furnaces with care and to make as little smoke as possible. At the hearing it was shown that the city was using soft coal on its self-propelling dump-scows. Mr. Jerome, in conclusion, supposed that the public would rather put up with the inconvenience of soft coal than have the elevated trains stopped. Meanwhile the Manhattan company is reducing the number of its trains on the shuttle lines and possibly on the Ninth Avenue.

A NEW YORK AND CHICAGO ROAD ASSOCIATION was organized in New York on June 16; the purposes being to further the construction of a broad, macadamized road to connect the two cities. The proposed route is from Fort Lee, N. J.; passes by way of Newburgh, Binghamton, Elmira, Jamestown in New York; Conneaut, Cleveland and Sandusky, in Ohio; Goshen, South Bend and Hammond, in Indiana, to Chicago. A convention is to meet at Atlantic City, on July 18 to consider the project. Col. Albert A. Pope, is President of the new association, and the principal associations of wheelmen and automobilists are represented in it.

## SEWAGE PURIFICATION WORKS AT DEPEW, N. Y.

By G. Everett Hill.*

The village of Depew lies about ten miles east of Buffalo. It is purely a manufacturing community, and its main industries are foundries and machine shops connected with railway interests. The village is traversed by four railroads, the New York Central, the Lehigh Valley, the Erie and the Lackawanna. It is well situated and well laid out; but the population is composed mainly of mechanics employed in the shops, so the houses, as a rule, are small and plain, and the per capita consumption of water is low. A few years ago the village contained about 4,000 people, but the loss of one of its principal industries was followed by the removal of many of the inhabitants, and its present population is about 2,900.

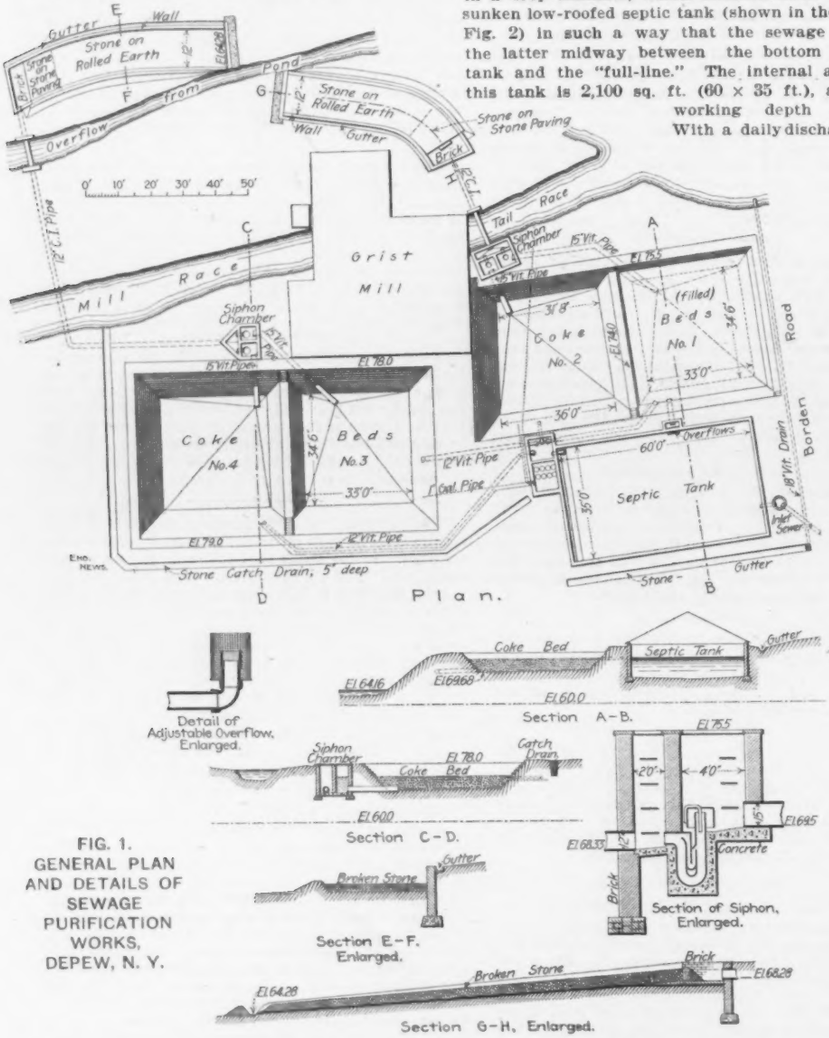


FIG. 1. GENERAL PLAN AND DETAILS OF SEWAGE PURIFICATION WORKS, DEPEW, N. Y.

Depew is sewered on the separate system, though a few street catch-basins have been connected with the sewers temporarily, under protest from the engineers. The sewage consists almost entirely of wastes of a domestic character; for, although much of it comes from factories and shops, the manufacturing is of such a nature that no considerable amount of liquid "trade refuse" is produced. The volume of flow in May, 1902, was not far from 100,000 gallons per day.

The natural drainage outlet of the territory covered by the village is Cayuga Creek, a stream widely variable in volume, but tortuous and—in places—with ill-defined banks. It was judged incapable of assimilating satisfactorily the sewage of the village, though complete purification was not considered necessary as its waters are not used for domestic supply.

*156 Fifth Ave., New York city.

The installation of purification works was undertaken in 1900. Circumstances made it necessary that the plant occupy the least possible area; that it be low in first cost; and that its operating expenses be but nominal. The system adopted, as best meeting these conditions, includes a septic tank, coke primary filters or "contact beds," and stone secondary filters on the wave-bed plan. The disposal works are located on a farm and grist-mill property bordering the creek. To fit the peculiar conformation of the land, and to preserve the buildings and approaches, it was necessary to scatter the several parts of the system, so that the works seem to lack unity and compactness.

Briefly stated, the design and operation of the plant (see the general plan and details, Fig. 1), are as follows: The incoming main sewer ends in a drop manhole, which communicates with a sunken low-roofed septic tank (shown in the view, Fig. 2) in such a way that the sewage enters the latter midway between the bottom of the tank and the "full-line." The internal area of this tank is 2,100 sq. ft. (60 × 35 ft.), and its working depth 6 ft. With a daily discharge of 100,000 gallons, it holds about 22 hours' average flow, and the average velocity through it is a little over ½-in. per minute. At this slow rate of travel the separation of the solids is very complete. The effluent escapes at the farther end through a collector of peculiar construction, which draws the sewage, without perceptible increase of velocity, from the whole width of the septic tank on a plane a little higher than midway between the sludge and the scum. The effluent from the tank contains no visible solids, and, on standing, deposits a barely perceptible dust-like sediment, more a discoloration than a sediment, for it has no appreciable depth. The tank has not been cleaned since its installation early in 1901. The writer visited the plant on April 24, 1902. The tank, at the outlet end, contained about 4¾ ins. of soft sludge. The inlet end was dark and no means were at hand for obtaining a light, so the depth of sludge there was not measured.

The sewage passes from the septic tank into a distributing chamber, whence four lines of pipe lead, respectively, to four coke-filled primary filters. Two of these beds are shown in use at 2. Each of these distributing lines is entered through a counterweighted valve, controlled, through a trace and rocker-shaft, by a pair of copper buckets, alternately filled and emptied. This mechanism is not described in detail, because it has not proved entirely satisfactory, though its shortcomings are only the occasional lapses which may be expected in automatic distribution controlled by moving mechanism. Subsequent works have been equipped with air-lock distribution. It is sufficient to say, concerning the Depew distribution, that the actuating buckets are filled by a small stream flowing from the bed in use when the water level in this bed has reached a point 3 ins. below the full-line; and that the operating valves are arranged so that any bed may be cut out of circuit by a turn of a four-way cock, the other three beds continuing to operate automatically in rotation.

At the present rate of flow, the main filling of each bed should take about 140 minutes. When the water is within 3 ins. of the top, it overflows (through an adjustable inlet in the coke-bed) into the controlling pipe leading back to the distributing chamber, discharging simultaneously into two of the eight buckets which actuate the valves. As these buckets fill, they fall, one closing the valve leading to the bed just filled, and the other opening the valve of the bed next to be used. The water continues to rise in the former, however, though very slowly, being admitted through a small by-pass, controlled by a valve which is set so that the bed will finish filling in about 80 minutes. This is the period of "resting full."

Each contact bed is connected by a 15-in. pipe with a siphon-chamber, and the liquid rises in this as it rises in the bed. When the full-line is reached, the siphon discharges the contents of the filter suddenly to the secondary bed. With three of these primary beds working thus in series, and one bed resting and held in reserve, the system operates on a seven-hour cycle, filling in 140 minutes, standing full 80 minutes, emptying and standing empty 200 minutes.

The secondary filters, or wave-beds, are two areas (a view of one of which is shown by Fig 3), each 12 × 60 ft., level in cross-section, but with a pitch of 1 on 15 longitudinally. Around the upper end of each bed and along its inner side is a brick retaining wall, flanked by a drainage gutter of channel-pipe, designed to keep out and carry away surface wash from the higher land. The outer edge of each bed is protected by a low earthen embankment, its inner face paved with stone to prevent washing. At the extreme upper end of each wave-bed, the ground is paved with brick, to catch and break the force of the strong and sudden discharge from the siphons. Below this, for 15 ft., the ground is paved with stone well rammed into place. Beyond this zone, the ground is simply rolled solid. Each wave-bed is filled with broken stone, the layer being 18 ins. deep at the upper end, where it overlaps the brick pavement, and 12 ins. deep at the lower end. The almost clean effluent from the contact beds travels through this stone in a wave and escapes at the lower end into the overflow channel from the mill-pond above the works. Each wave drives out the gaseous contents of the filtering material, and, passing, draws fresh air in behind it. The aeration is very complete, and no trace of stored organic matter has ever been evident in these wave-beds. The effluent is clear, sparkling, colorless and odorless. No determinations have been made of ammonias or oxygen consumed; but frequent storage of samples at incubating temperature has yielded not the slightest trace of putrefactive change, save in a single instance when a sample became for one day very faintly malodorous. Numerous analyses made at another plant operating under similar conditions showed an average purification of about 85% measured by reduction of ammonias.

In the Depew installation, the wave-beds are so small that each discharge of a siphon floods its corresponding bed from end to end and from the floor to the surface of the stone. In later installa-

tions their relative size has been increased, so that the discharge of the siphon ceases some time before the effluent appears at the lower end, and the surface of the filtering material is never wet (save by rain), the sewage passing through the bed instead of flooding it.

It is not claimed that any considerable oxidation is accomplished in these beds. Their function is rather, to introduce into a partially purified sewage a measure of dissolved oxygen sufficient to prevent any reversion to anaerobic conditions. This they seem to accomplish.

In designing the Depew works, it was recognized that the location chosen for the wave-beds was subject to inundation during the spring freshets. No other site was available, and the only alternative was the adoption of a pumping system. It was decided that occasional repairs to the wave-beds would be cheaper than constant pumping, and the works were built with this in view. The floods in 1902 were unusually severe. Not only were the wave-beds submerged, but the creek invaded the contact filters and carried into them so much mud that their capacity is seriously impaired. It will be necessary to remove, wash and replace the coke, in addition to cleaning the wave-beds. Save for some slight alterations in the distributing gear, no other repairs have been necessary. The system is under the charge of the street superintendent, who makes occasional visits of inspection. The greatest care of operation is the cutting of the grass around the beds.

The plant was designed by the City-Wastes Disposal Co., of New York, and built by a local contractor under the supervision of Frederick K. Wing, C. E., of Buffalo, who is engineer for the village.

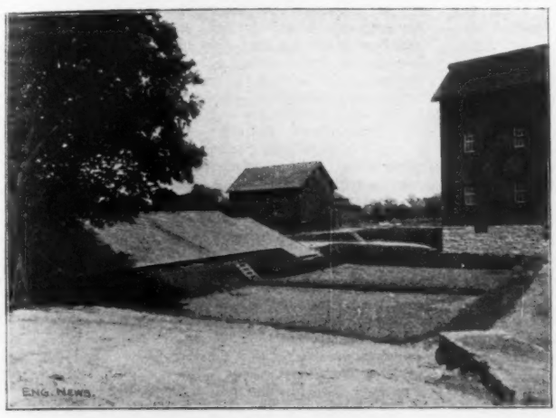


FIG. 2. COVERED SEPTIC TANK AND TWO PRIMARY COKE BEDS.

FIG. 3. VIEW OF ONE OF THE WAVE OR SECONDARY BEDS.

FIGS. 2 AND 3. VIEWS OF SEWAGE PURIFICATION WORKS AT DEPEW, N. Y.

## THE DESIRABILITY OF USING A SINGLE GRADE OF STEEL FOR BRIDGES.

At the meeting of the American Society for Testing Materials, held at Atlantic City, N. J., June 12-14, the question: Is it Desirable to Specify a Single Grade of Open Hearth Structural Steel for Bridges of Ordinary Span? was discussed by Messrs. A. P. Boller, Theodore Cooper, J. E. Greiner, C. C. Schneider, and J. P. Snow, M.'s Am. Soc. C. E. The remarks of these gentlemen are given in abstract below:

### By A. P. Boller.*

The topic under discussion can be answered in the affirmative, excepting as to rivets and eye-bar material. There is no reason why plates and shapes should not be a single grade open hearth for such bridges, but eye-bar material, subject as it is to the subduing effects of forging and annealing, should be of a higher grade of material. For large spans, which are rarely, if ever, committed to the care of other than expert bridge engineers, it is impracticable to set up any standard of uniformity, and the character and adaptation of the steel must be entirely in the hands of such engineers. These cases involve so many special considerations, that no rule can be laid down, and any engineer qualified to design and administer the construction of such works, is sufficiently well informed of mill possibilities as not to require impossible or impracticable results.

*Consulting Engineer, 1 Nassau St., New York city.

It may be of interest, in this connection, to note the table of steel requirements adopted by my firm, and on which some 30,000 tons of bridge material are now being gotten out for the Wabash entrance into Pittsburg, for all types of construction; from the ordinary girder spans to the great cantilever constructions over the Monongahela and Ohio rivers, where the limits of pin-connected work are believed to have been reached.

| Shape. | Ultimate strength, per sq. in. | | Per cent. | | | Chemical composition below. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Minimum | | Reduction of area. | P. | | S. | | |
| | Minimum. | Maximum. | Elastic ratio. | Elongation in 8 ins. | | Acid. | Basic. | Acid. | Basic. | Mn. |
| Rivet ..... | 52,000 | 63,000 | 55 | 28 | 50 | 0.04 | 0.03 | 0.05 | 0.05 | 0.60 |
| Angles ..... | 60,000 | 70,000 | 50 | 24 | 40 | .06 | .04 | .05 | .05 | .60 |
| Plates ..... | 60,000 | 70,000 | 50 | 24 | 40 | .06 | .04 | .05 | .05 | .60 |
| Eye bars .... | 63,000 | 73,000 | 50 | 24 | 40 | .06 | .03 | .04 | .04 | .60 |
| Cast steel .... | 65,000 | 75,000 | 50 | 20 | 30 | .08 | .04 | .05 | .05 | .80 |
| Pins ..... | 65,000 | 75,000 | 50 | in 2 ins. 22 | 33 | .06 | .04 | .05 | .05 | .60 |

This table shows a practical uniformity in all material, other than in the rivet, eye-bar and pin requirements, and is believed to be as reasonable a demand on the mills as the present state of the art permits, and yet permits of the engineer exercising such judgment in selecting his material as the nature of the work demands.

### By Theodore Cooper.*

The evolution of the use of steel for structural purposes in this country may be said to have started about 1870, when Mr. Wm. Butcher convinced Capt. James. B. Eads that he could furnish him steel of 100,000 lbs. tensile strength, able to stand without permanent set 60,000 lbs. compression and 40,000 lbs. tension. The metallurgical, mechanical and financial struggles of this experiment, while full of interest and instruction, were sufficient to discourage for some years further efforts in this line.

The next step of which the writer had personal experience, was the "Hay" steel experiment of the Glasgow Bridge in 1878. This bridge was finally built of acid Bessemer steel.

About 1887 basic soft steel could be obtained on more favorable terms than iron of the same sections. From that time until now we have recognized two standard grades of structural steel, when, as was then true, they were really two different metals, viz: Basic soft steel and acid Bessemer medium steel, and especially during the gradual disappearance of the metal iron and recognition of the new metal, the two grades were proper and necessary. Now practically these two grades are merely overlapping ranges of the same material. Under the Manufacturers' specifications steel from 60,000 to 62,000 lbs. is both "soft" and "medium" and it is natural that where the orders for the two classes are equally probable, the objective point will be for material to suit either order.

Believing that both the interests of the steel manufacturers and of the steel users will be advanced by the adoption of *one common standard* I think the time has come to advocate the same. But do not understand me to mean that we have yet got a material, with which either the maker or user should or can be satisfied. But we can perhaps determine a common objective point or average material for a standard and the struggle of the immediate future, instead of being devoted to getting miscellaneous varieties of steel to suit individual tastes or vagaries, should be to improve and perfect that one standard. With one average material in view the steel manufacturer should be able to systemize his output to give far greater uniformity than he has heretofore. The users of steel under the *one standard material* should demand an important reduction in the limits of variation from the standard average. Under the present limits demanded by the manufacturers of steel, there is a difference of 10,000 lbs. between the *minimum* which determines the strength of our ships, bridges and other structures and the *maximum*, which measures the workability of the material.

In spite of the manufacturers' limit of 10,000 lbs. there has been no difficulty for years in getting this limit reduced to 8,000 lbs. Is it chimerical then to believe that with one class of material in view we can get this reduced to 6,000 lbs.? If this result can be had, as I believe, why should we bend, form, work and punch steel of 70,000 lbs. to get a ship or bridge rated at 60,000 lbs. The difference in workability of 4,000 lbs. is worth money and the manufacturer who can give the most uniform material should be favored even at an advanced price.

In advocating one standard structural material, I have in view all structures and not simply bridges. There is no just reason why the material for ships, bridges or buildings should be different, and there will be no gain in the character of our material, unless we can harmonize the requirements to suit all.

What is the average material which would meet the views and needs of shipbuilders, manufacturers of structural work, steel makers and engineers, under the expectation of the future material being more uniform than we are now offered? I suppose it will lie somewhere between 60,000 and 66,000 lbs., many perhaps considering one too low and the other too high.

Personally, I should consider under the above claims, an average of 65,000 lbs. steel or steel varying between the limits of 62,000 and 68,000 lbs. as the ideal material we should expect. The ductility and other qualities being at least equal to those now required of medium steel.

### By J. E. Greiner.*

There were a number of conservative engineers who made a strong fight for the retention of wrought iron for structural purposes, and who kept up their struggle so long as iron could be obtained. Some of these engineers had a very unsatisfactory experience with steel structures and naturally preferred to adhere to a metal whose quality had been determined by long and continued use. A number of these engineers were of such standing as to give weight to their opinions. As a consequence the total replacing of rolled iron by rolled steel was a gradual process, although it lasted but a couple of years.

When it became very difficult to obtain a good wrought iron, this conservative element permitted the use of steel for certain parts of bridges, such as web plates in girders and eye bars in trusses, and finally, even when wrought iron was no longer obtainable it was still called for in specifications. The contractor in such cases was given the privilege of substituting a very soft steel, section for section.

In the meantime those who had entered the field of steel had made a sufficient number of tests to satisfy them that open-hearth steel varying from 52,000 to 65,000 lbs. could stand more abuse than the best double rolled iron. It could be punched and sheared when thickness did not exceed ⅝-in. with no greater injury. When the ultimate

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strength ran over about 68,000 lbs. punching and shearing had a tendency to injure the metal, but it was found that this damage could be removed by reaming and planing.

These conditions then naturally suggested two grades of steel, namely, a soft steel to be worked the same as wrought iron, and a medium steel in which all holes are to be reamed or drilled and all sheared edges planed off.

It has been the general practice for the past six or eight years for bridge engineers to specify these two grades, the soft being used as a substitute for wrought iron, and the medium for eye bars, or members which were to have holes reamed or drilled and edges planed, and to be used in structures of such magnitude that the saving in weight justified the more expensive shop work.

Engineers should keep pace with the times. The so-called soft steels served their time after they had quieted the nerves of the conservatives. That time has passed, and at present there is no material difference in the working qualities of the soft and medium steels as usually furnished and accepted. Either grade can be rolled from the same billet.

Some engineers have recently advocated the adoption of a soft steel limit between 52,000 and 58,000 lbs., and a medium grade between 62,000 and 68,000 lbs. It was desired to have a more decided distinction between the two, as well as to destroy the manufacturers' opportunity of supplying either from the same billet.

Such a classification is even more absurd than the present common practice. It would bar out what is really the best range for structural steel.

All things considered an open-hearth steel ranging from 55,000 to 65,000 lbs. is about as satisfactory as can be obtained for structural purposes. It will meet all of the requirements for soft steel and will be about as strong as is usually accepted for medium. Such a steel can be worked under the same conditions as wrought iron, will be just as safe and unit stresses may be taken 20% greater. This has been the writer's practice for the past two years and is embodied in the B. & O. Railroad specifications for 1901.

A single grade as above outlined will sooner or later become standard. If not recommended by some technical association of high standing, it is quite possible that the manufacturers will realize the advantages of such a single grade, not only to themselves, but to the users as well, and then we will be offered the choice of either accepting the standard product of their mills or paying a fancy price to gratify our own desires. The adoption of a single grade of open-hearth steel for structural purposes would not bar out the production of a special grade for use in very large structures where the dead load is a controlling factor in the design. The material for such structures, however, should be rolled in accordance with special specifications and not with general or standard ones. Neither would the adoption of a single grade of structural steel affect the present soft steel output for rivets. We are not yet ready to use anything but a very soft steel for rivets, especially when driven by hand. When all riveting is done by power, there can be no objection to using the single grade steel as above outlined, even for rivets.

### By C. C. Schneider.*

The writer desires to depart from the strict wording of the question and discuss the desirability of using one grade of steel for all ordinary structures, including material for ship building. If there is any advantage to the manufacturer in using a single grade of steel for railroad bridges, the advantage would be so much greater if the manufacturer of structural material could confine himself to that one grade entirely, excepting when special steel is required for structures of unusual magnitude, which occurs only once in several years. This question: "Is it desirable to specify one grade of steel for all structural work," may be answered by asking another question, viz: "Why do we use two grades of steel?"

The reason for this becomes apparent if we follow the history of bridge building in the country from the time when steel was first used as a structural material. In the earlier days steel was used only in structures of what was then considered unusual magnitude and only in certain members for the purpose of reducing the dead load and the sizes of the heaviest pieces, as at that time even the largest bridge shops were not fitted up for handling heavy work. To accomplish this, and also for reasons of economy, as steel was much more expensive than wrought iron and could be produced with a high ultimate strength and high elastic limit was specified and the working strains increased in proportion.

As engineers gained more knowledge of the properties of steel, it was recognized that this very high steel was not a safe material for railroad bridges, as it was not well adapted to resist impact. Engineers then commenced to specify more ductility and lower ultimate strength, and continued to lower their requirements for ultimate strength as the price of steel decreased until the usual practice had come down from over 100,000 lbs. to about 62,000 to 70,000 lbs., or what is now classed as medium steel. Table I. gives the ultimate strengths specified for some of the more important bridges made of steel.

The *extensive* use of steel as a structural material did not commence until the year 1890. Before that time steel was used only in isolated cases or for heavier work, such as chords and eyebars for larger bridges. About 1890 some railroads commenced to build even smaller spans and plate girders of steel, and for eyebars steel was almost exclusively used. At about that time most of the structural mills that had formerly manufactured wrought iron had equipped themselves with steel furnaces, but continued for some time to make both kinds of material, until they found it more profitable to confine themselves to the manufacture of structural steel only and discontinued the manufacture of wrought iron. In 1894 it was practically impossible to obtain wrought-iron shapes, and those engineers who would have preferred wrought iron were obliged to use steel instead, and naturally specified a grade of steel as near wrought iron as possible, using also the same unit strains and workmanship as for wrought iron.

This accounts for the two grades of steel being at present in use—medium steel by the advocate of steel, soft steel by the advocates of wrought iron. As steel has now been extensively used for structural work for a long time, medium steel for at least 20 years and soft steel for at least 10 years, we certainly have passed the experimental stage and should be in a position to decide for *one* grade of steel for ordinary structural work. This will be of advantage to the producer and consumer. The manufacturer of steel will be able to conduct his business in a more systematic and rational manner than he can do at the present time. If he uses the same quality of stock he will be able to use the same mixture and obtain uniform results satisfactory to the specifications. The manufacturer of bridges and structural work will be able to keep the usual sizes of shapes and plates in stock, more particularly those of which there are only a few sizes rolled and which are very hard to obtain on short notice because the quantities used for each structure are small, such as fillers, stiffening angles, tie plates, lattice bars, connection angles, etc. This would therefore facilitate deliveries. The consumer will naturally also be benefited by the greater uniformity of the material which will result from only *one* grade of steel being manufactured.

There is still another reason why this association should take a decided stand in favor of one grade of steel, and that is, that all other countries which have adopted standard specifications use only one grade of steel for structural work, and as the object of this association is to establish a uniform practice all over the world, we cannot except other countries to adopt our practice unless we have something practical and reasonable to offer which appeals alike to the manufacturer as well as the engineer. Crank specifications will certainly meet the opposition of the manufacturers abroad. Now admitting that it is desirable to use one grade of steel only, the question arises, what is the proper grade of steel for structural work? In deciding this question, we should consider the process of manufacture in its present state and the probabilities of the future. At present most of the structural steel is made by the basic process and appearances indicate that the basic process will also be the process of the future for ordinary structural steel. It would, therefore, seem expedient to adopt a grade best suited to the basic process. For special higher grades of steel, the acid process will probably hold its own.

The most satisfactory material which can be produced by the basic process averages about 58,000 to 60,000 lbs.; the writer would therefore recommend an ultimate strength of 60,000 lbs. per square inch, varying 5,000 lbs. either way. This grade of steel, in the writer's opinion, may be used without planing or reaming up to a thickness of about ⅝-in. without impairing its strength. Table II. appended hereto gives the grades of steel used for bridges and structural work in some of the countries which have adopted standard specifications. After having agreed on the proper grade of structural steel, the next question to decide is the quality. The quality is determined by the elongation, the bending test and the appearance of the fracture. As far as the elongation is concerned, we notice in the specifications adopted by the Federal Council of Switzerland, and by the Austrian Government, that the specified elongation varies with the ultimate strength. The Swiss specifications limit the product of the ultimate strength multiplied by the percentage of elongation in 8 ins. to not less than 1,280,000, and call this the coefficient of quality. The writer prepared Specifications for Railroad Bridges in 1886, which were published in 1887 as the specifications of the Pencoyd Iron Works, wherein the quality of steel was specified as follows:

> Steel having an ultimate strength of 55,000 to 80,000 lbs. per square inch, when tested in samples of at least ½ sq. in. section cut from the finished products, will be accepted for the different parts of structures, provided it shows the following qualities:
>
> The elastic limit shall be at least 0.6 of the ultimate strength.
>
> The product of the ultimate strength per square inch in pounds multiplied by the percentage of elongation in 8 ins. shall be at least 1,500,000.

This value was found by examining a great number of tests, of which only those were selected which proved, by the elastic limit, the elongation, the bending test and the fracture, the good quality of the steel. A similar coefficient was also incorporated in the Bridge Builders' Specifications, published about the same time.

As this appears to be a consistent and reasonable method to establish the quality of the material by varying the elongation with ultimate strength, the writer begs leave to submit this question to this association for consideration and discussion, and also the question whether the measuring of the elastic limit or yield point is of any practical value in establishing the quality of the steel.

### By J. P. Snow.*

I favor a single grade of steel for structural purposes

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*American Bridge Co., 100 Broadway, New York City.

TABLE I.—Showing Tensile Strength and Elongation of Steel Used on Notable Bridges.

| Year of completion. | River. | Description. | Ultimate strength in lbs. per sq. in. |
|---|---|---|---|
| 1874. | Mississippi. | Arches, St. Louis | 100,000 min. |
| 1880. | Missouri. | Plattsmouth Bridge | 80,000 " |
| 1882. | Missouri. | Bismarck, Compression | 80,000 to 90,000 |
| | | Bismarck, Tension | 70,000 to 80,000 |
| 1882. | East River. | Brooklyn Bridge, excluding wire | 70,000 min. |
| 1883. | Niagara. | Cantilever | 80,000 " |
| 1884. | Susquehanna. | Balt. & Ohio R. R., Compression | 80,000 " |
| | | Balt. & Ohio R. R., Tension | 70,000 " |
| 1885. | Arkansas. | Van Buren Bridge, Compression | 80,000 " |
| | | Van Buren Bridge, Tension | 70,000 " |
| 1885. | Ohio. | Ky. & Indiana, Cantilever, Compression | 80,000 " |
| | | Ky. & Indiana, Cantilever, Tension | 70,000 " |
| 1886. | Harlem. | Washington Arch, New York | 62,000 to 70,000 |
| 1887. | Missouri. | Sibley Bridge, Atch., Top. & S. Fe, Compression | 75,000 to 85,000 |
| | | Sibley Bridge, Atch., Top. & S. Fe, Tension | 60,000 to 70,000 |
| 1888. | Missouri. | Omaha, Compression | 80,000 min. |
| | | Omaha, Tension | 70,000 " |
| 1888. | Mississippi. | Cairo Bridge | 67,000 to 75,000 |
| 1888. | Ohio. | C. & O. Ry., Cincinnati and Covington, Compression | 64,000 to 72,000 |
| | | C. & O. Ry., Cincinnati and Covington, Tension | 58,000 to 66,500 |
| 1890. | Firth of Forth. | Cantilever, Scotland., Compression | 76,000 to 83,000 |
| | | Cantilever, Scotland., Tension | 67,000 to 74,000 |
| 1890. | Colorado. | Red Rock, Cantilever, Compression | 64,000 to 72,000 |
| | | Red Rock, Cantilever, Tension | 58,500 to 66,500 |
| 1890. | Mississippi. | Merchants' Bridge, St. Louis | 67,000 to 75,000 |
| 1891. | Ohio. | Cantilever, Ry., Cincinnati | 62,000 to 70,000 |
| 1892. | Mississippi. | Memphis Cantilever, Main trusses | 69,000 to 78,500 |
| | | Memphis Cantilever, The rest | 64,000 to 72,500 |
| 1893. | Mississippi. | Bellefontaine | 62,000 to 70,000 |
| 1895. | Delaware. | Penn. R. R., Philadelphia, Main trusses | 62,000 to 70,000 |
| | | Penn. R. R., Philadelphia, The rest | 50,000 to 60,000 |
| 1897. | Niagara. | Double-deck bridge | 60,000 to 68,000 |
| 1898. | Niagara. | Highway arch | 60,000 to 68,000 |

TABLE II.—Showing Grades of Steel Used for Bridges and Buildings in Some of the Countries Which Have Adopted Standard Specifications.

| Name of the authority or society. | Kind of material. | Tenacity tests—Tenacity, lbs. per sq. in. | Tenacity tests—Elongation in 8 ins., % |
|---|---|---|---|
| French Ministry of Public Works, August, 1891 | Plates and bars at least | 60,000 | 22 |
| | Rivets at least | 54,000 | 28 |
| Austrian Ministry of Commerce, 1892 | Plates and bars, lengthwise | 50,000 to 64,000 | 28—22 |
| | Transverse | 50'000 to 64,000 | 26—20 |
| | Rivets | 50,000 to 57,000 | 32—26 |
| Standard specifications of German Societies, 1892 | Bars and plates (of ¼ to 1½ ins. thickness) lengthwise | 53,000 to 63,000 | 20 |
| | Transverse | 51,000 to 64,000 | 17 |
| | Rivets and screws | 51,000 to 60,000 | 22 |
| Federal Council of Switzerland, 1892 | Bars and short plates | 51,000 to 64,000 | 25—20 |
| | Long plates, lengthwise | 51,000 to 64,000 | 25—20 |
| | Long plates, transverse | 51,000 to 64,000 | 22—18 |
| | Rivets and screws | 51,000 to 60,000 | 28—24 |

for these reasons: (1) Because there is really no defensible argument why all ordinary bridges should not be made of the same class of metal. These bridges are essentially alike in the service to which they are subjected and what is best for one is best for all. (2) If one grade is used by all builders the melters and other workmen at the mills will become expert in the manufacture of this grade and the product will be more uniform and all the melts will hit the average of the range much more closely than is now the case when the workmen are called upon to produce material all the way from extra soft to quite hard. (3) If a uniform grade is specified by all buyers of bridges the shops will not experience the trouble that they now do from the impossibility of using stock bought for other bridges to fill up gaps in a job on which they are at work.

I would not, however, agree to a single grade unless it covers soft steel. I prefer a steel averaging 57,000 lbs. ultimate strength per square inch with a range of 4,000 lbs. each way, but will join in approving an average if not exceeding 60,000 lbs. with a range not exceeding 5,000 lbs. each way.

I am aware that many prefer what is called medium steel, ranging up to 70,000 lbs. ultimate. My objection to this is: (1) That although the punched holes are reamed and the sheared edges planed, the whole of the danger from rough treatment may not be removed. The damage done to steel by the punch and shear lies in compressing it locally far beyond its limit of recovery, thereby rendering it unfit to resist tension. We demonstrate this when we bend a wire back and forth until it becomes so brittle that it breaks short off. The gag of the straightening press, cold rolling and severe local hammering produce practically the same effect as the punch and shear, but reaming and planing do not remove these latter injuries.

Secondly, reamed medium steel with higher units and correspondingly lighter sections does not make so rigid a bridge as soft steel with low units and heavier sections, although its ultimate strength may be as great or even greater. The true value of a bridge consists in its stiffness and rigidity coupled with strains below the elastic limit. If light and subject to much motion under service a bridge is condemned if the units strains reach a certain maximum without considering whether the steel is soft or medium or whether the holes are punched, reamed or drilled. These, among other reasons, lead me to prefer soft steel which is not seriously injured by reasonable treatment if the metal is not too thick.

## THE PERMEABILITY OF CONCRETE UNDER HIGH WATER PRESSURES.*

By J. B. McIntyre and A. L. True.

### INTRODUCTION.

The tests described below were undertaken to find, if possible by experiment, a concrete which would be impermeable to water under high pressures, in the belief that, as during the past few years concrete has come into use in almost every conceivable way, the results of a series of tests might possess some practical value.

Tests have been made on almost every quality and condition of concrete, but there are few or no published results relative to its permeability under high pressures. Mr. F. P. Stearns, Chief Engineer of the Metropolitan Water and Sewerage Board, in answer to an inquiry on the subject, states that a good many experiments have been conducted at Clinton, Mass., relative to the degree of imperviousness of mortar of various kinds, but that the results have not been published as yet or put in such shape that they could be furnished to anyone. As the result of his experience, however, he recommended a Portland cement concrete in the proportion of 4 parts stone, 2.5 parts of sand and 1 part cement.

Mr. Geo. W. Rafter, in a paper read before the American Society of Civil Engineers (1899, Vol. 42, page 148) on the theory of concrete, says that for water tightness a concrete with mortar about 40 or 45% of the aggregate should be used, but no account of actual experiments is given. In the discussion following this paper, Mr. Allen Hazen states that in his opinion 40% of mortar would be inadequate to fill the voids. Prof. Ira O. Baker agrees with Mr. Hazen.

Results of experiments upon the permeability of concrete are shown in a diagram in Johnson's "Materials of Construction" giving the results of filtration through Portland cement concrete. A series of tests was made by Messrs. Sooysmith & Co. on the porosity of cement mortar, but the results of neither of these can be considered a parallel case to permeability under high pressures, for in both these cases the water was simply allowed to stand in hollow cubes and the amount of absorption noted. Nor can any comparison be drawn, owing to lack of necessary data in the reports and to the great differences in the methods of procedure.

*Abstract of a graduating thesis presented to the Thayer School of Civil Engineering, April, 1902. Experiments made, January to March, 1902.

### MATERIALS AND CONDITIONS.

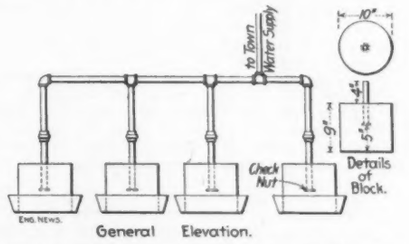
For our experiments two brands of cement were used, which we will designate as No. 1 and No. 2, No. 1 being chosen as being a standard brand of Portland cement, and No. 2 because much was claimed by its manufacturers as to its imperviousness.

The proportions of the concrete were varied by using 30, 35, 40 and 45% of mortar to the entire mixture, and in each case the mortar was varied in the proportions of 1 part cement to 1, 2 and 3 parts of sand.

Specimens of both No. 1 and No. 2 were made in pairs, to provide against defects; thus, of each different proportion of concrete there were four specimens, two of No. 1 and two of No. 2. A few specimens were also made from No. 1 brand in the proportions 1 : 2 : 4; 1 : 2.5 : 4, and 1 : 2.5 : 5, being so called standard mixtures. In all 56 specimens were made.

The gravel and sand were the best obtainable in the vicinity, the sand being a good quality of bank sand, carefully screened and containing 36% of voids, while the gravel, although selected, was below the usual standard. It contained 33% of voids, the largest stones having a diameter of an inch or a little more.

The specimens were cylindrical in form, 9 ins. high and 10 ins. in diameter, with an 8-in. length of ¾-in. pipe inserted to a depth of 4 ins. in the top, thus leaving at least 5 ins. of concrete in every direction to be penetrated by the water. Around the bottom of the pipe a check-nut was placed, and this was surrounded by a little neat cement to prevent the water forcing its way to the top along the pipe.




Sketch Illustrating Apparatus for Testing the Permeability of Concrete.

Great care was taken in the mixing to insure the uniformity of quality. The proper proportions of sand and cement were first thoroughly mixed; then the gravel and water added, and the whole turned until the concrete was ready. The concrete was then placed in galvanized iron molds in layers of about 3 ins. and solidly rammed with a wooden ram. When a depth of 5 ins. was reached the iron pipe was put in place, the pat of neat cement rammed around it, and the mold filled to the top.

The completed specimens were kept under a damp cloth for 24 hours, when they were taken from the molds, and soon after were placed under water, where they were allowed to set for a month before being tested.

### TESTS.

Twenty-four hours before the tests were to begin the specimens were taken from the water and allowed to dry. As it was found that, in some cases, from an eighth of an inch to an inch of mortar had forced its way up into the pipe, they were all carefully drilled to the end of the pipe, in order that the water might come in contact with the concrete itself.

The tests were made by attaching the specimens directly to the town water supply, securing a pressure of 20, 40 and 80 lbs. per sq. in. The tests lasted for two hours, and all the specimens were weighed both before and after on Fairbanks' standard scales, weighing down to two grams, in order to ascertain the amount of water absorbed or allowed to percolate. In cases where water came through in sufficient quantity to drip, it was caught in pans beneath the specimens.

The results are given in the accompanying tables, which need no explanation.

### CONCLUSION.

From the tables it will be seen that several of the mixtures were practically impermeable to water at the pressures which we had at our disposal, nearly from 20 to 80 lbs. per sq. in.

All the specimens composed of 1 : 1 mortar in the proportion of 30, 35, 40 and 45% of the whole mass were impermeable. Some of the specimens composed of 1 : 2 mortar in the proportions of 40 and 45% were also impermeable, as well as the mixtures 1 : 2 : 4 and 1 : 2.5 : 4.

All others leaked at the high pressure, and in a general way may be said to have shown a degree

Results of Tests of Concrete Under Hydrostatic Pressure.

| Specimen No. | Brand No. | Proportions Mortar, % | Proportions Cement to sand. | Water absorbed, grams. | Remarks. |
|---|---|---|---|---|---|
| Pressure, 80 lbs.; time, 2 hours. | | | | | |
| 7 | 1 | 30 | 1 : 1 | 20 | No leak. |
| 7a | 1 | 30 | 1 : 1 | 20 | No leak. |
| 8 | 1 | 30 | 1 : 2 | 10 | No leak. |
| 8a | 1 | 30 | 1 : 2 | 100 | Leaked. |
| 9 | 1 | 30 | 1 : 3 | ... | Defective. |
| 9a | 1 | 30 | 1 : 3 | 390 | Leaked. |
| 10 | 1 | 35 | 1 : 1 | 10 | No leak. |
| 10a | 1 | 35 | 1 : 1 | 40 | No leak. |
| 11 | 1 | 35 | 1 : 2 | 40 | No leak. |
| 11a | 1 | 35 | 1 : 2 | 50 | Leaked. |
| 12 | 1 | 35 | 1 : 3 | 310 | Leaked. |
| 12a | 1 | 35 | 1 : 3 | 150 | Leaked. |
| 13 | 1 | 40 | 1 : 1 | ... | Defective. |
| 13a | 1 | 40 | 1 : 1 | 40 | No leak. |
| 14 | 1 | 40 | 1 : 2 | 120 | Leaked. |
| 14a | 1 | 40 | 1 : 2 | 0 | No leak. |
| 5 | 1 | 40 | 1 : 3 | 480 | Leaked. |
| 5a | 1 | 40 | 1 : 3 | 390 | Leaked. |
| 15 | 1 | 45 | 1 : 1 | 75 | No leak. |
| 15a | 1 | 45 | 1 : 1 | 40 | No leak. |
| 16 | 1 | 45 | 1 : 2 | 40 | No leak. |
| 16a | 1 | 45 | 1 : 2 | 120 | Leaked. |
| 4 | 1 | 45 | 1 : 3 | 100 | Leaked. |
| 4a | 1 | 45 | 1 : 3 | 500 | Leaked. |
| 17 | 2 | 30 | 1 : 1 | 30 | No leak. |
| 17a | 2 | 30 | 1 : 1 | 30 | No leak. |
| 18 | 2 | 30 | 1 : 2 | 350 | Leaked. |
| 18a | 2 | 30 | 1 : 2 | 200 | Leaked. |
| 19 | 2 | 30 | 1 : 3 | 300 | Leaked. |
| 19a | 2 | 30 | 1 : 3 | 590 | Leaked. |
| 20 | 2 | 35 | 1 : 1 | 30 | No leak. |
| 20a | 2 | 35 | 1 : 1 | 40 | No leak. |
| 21 | 2 | 35 | 1 : 2 | 80 | Leaked. |
| 21a | 2 | 35 | 1 : 2 | 270 | Leaked. |
| 22 | 2 | 35 | 1 : 3 | 620 | Leaked. |
| 22a | 2 | 35 | 1 : 3 | 340 | Leaked. |
| 23 | 2 | 40 | 1 : 1 | 40 | No leak. |
| 23a | 2 | 40 | 1 : 1 | 20 | No leak. |
| 24 | 2 | 40 | 1 : 2 | 800 | Leaked. |
| 24a | 2 | 40 | 1 : 2 | 410 | Leaked. |
| 25 | 2 | 40 | 1 : 3 | ... | Leaked. |
| 25a | 2 | 40 | 1 : 3 | 110 | Leaked. |
| 26 | 2 | 45 | 1 : 1 | 60 | No leak. |
| 26a | 2 | 45 | 1 : 1 | 20 | No leak. |
| 27 | 2 | 45 | 1 : 2 | 380 | Leaked. |
| 27a | 2 | 45 | 1 : 2 | 220 | Leaked. |
| 1 | 1 | 1 : 2.0 : 4 | | 0 | No leak. |
| 1a | 1 | 1 : 2.0 : 4 | | 0 | No leak. |
| 2 | 1 | 1 : 2.5 : 4 | | 180 | Leaked. |
| 2a | 1 | 1 : 2.5 : 4 | | 0 | No leak. |
| 3 | 1 | 1 : 2.5 : 5 | | 140 | Leaked. |
| 3a | 1 | 1 : 2.5 : 5 | | 550 | Leaked. |
| Pressure, 20 lbs.; time, 2 hours. | | | | | |
| 5 | 1 | 40 | 1 : 3 | 150 | Leaked. |
| 12 | 1 | 35 | 1 : 3 | 50 | Leaked. |
| 12a | 1 | 35 | 1 : 3 | 90 | Leaked. |
| 18 | 2 | 30 | 1 : 2 | 130 | Leaked. |
| 18a | 2 | 30 | 1 : 2 | 110 | Leaked. |
| 19 | 2 | 30 | 1 : 3 | 130 | Leaked. |
| 19a | 2 | 30 | 1 : 3 | 150 | Leaked. |
| 22 | 2 | 35 | 1 : 3 | 150 | Leaked. |
| 22a | 2 | 35 | 1 : 3 | 550 | Leaked. |
| 24 | 2 | 40 | 1 : 2 | 80 | Leaked. |
| 24a | 2 | 40 | 1 : 2 | 120 | Leaked. |
| 25 | 2 | 40 | 1 : 3 | 80 | Leaked. |
| 25a | 2 | 40 | 1 : 3 | 140 | Leaked. |
| 2 | 1 | 1 : 2.5 : 4 | | 10 | No leak. |
| 3 | 1 | 1 : 2.5 : 5 | | 10 | No leak. |
| 3a | 1 | 1 : 2.5 : 5 | | 80 | Leaked. |
| Pressure, 40 lbs.; time, 2 hours. | | | | | |
| 4 | 1 | 45 | 1 : 3 | 0 | No leak. |
| 4a | 1 | 45 | 1 : 3 | 0 | No leak. |
| 5a | 1 | 40 | 1 : 3 | 390 | Leaked. |
| 8a | 1 | 30 | 1 : 2 | 10 | No leak. |
| 9a | 1 | 30 | 1 : 3 | 10 | No leak. |
| 11 | 1 | 35 | 1 : 2 | 10 | No leak. |
| 11a | 1 | 35 | 1 : 2 | 50 | No leak. |
| 12 | 1 | 35 | 1 : 3 | 50 | Leaked. |
| 12a | 1 | 35 | 1 : 3 | 80 | Leaked. |
| 14 | 1 | 40 | 1 : 2 | 80 | No leak. |
| 16a | 1 | 45 | 1 : 2 | 10 | No leak. |
| 18 | 2 | 30 | 1 : 2 | 200 | Leaked. |
| 18a | 2 | 30 | 1 : 2 | 150 | Leaked. |
| 19 | 2 | 30 | 1 : 3 | 260 | Leaked. |
| 19a | 2 | 30 | 1 : 3 | 60 | Leaked. |
| 21 | 2 | 35 | 1 : 2 | 60 | No leak. |
| 21a | 2 | 35 | 1 : 2 | 50 | No leak. |
| 22 | 2 | 35 | 1 : 3 | 890 | Leaked. |
| 22a | 2 | 35 | 1 : 3 | 550 | Leaked. |
| 24 | 2 | 40 | 1 : 2 | 450 | Leaked. |
| 24a | 2 | 40 | 1 : 2 | 550 | Leaked. |
| 25 | 2 | 40 | 1 : 3 | 400 | Leaked. |
| 25a | 2 | 40 | 1 : 3 | 540 | Leaked. |
| 27 | 2 | 45 | 1 : 2 | ... | Defective. |
| 27a | 2 | 45 | 1 : 2 | 80 | Leaked. |
| 2 | 1 | 1 : 2.5 : 4 | | 50 | Leaked. |
| 3 | 1 | 1 : 2.5 : 5 | | 120 | Leaked. |
| 3a | 1 | 1 : 2.5 : 5 | | 560 | Leaked. |

Nos. 1, 1a, and 2a were left under 80 lbs. pressure for six consecutive days with no sign of leakage.

of imperviousness in direct proportion to the proportion of the mortar in them, with the lower pressures, as well as with 80 lbs. However, as the object was to secure an impermeable product, the greatest attention was devoted to those mixtures which withstood the high pressure.

In the tests it has been assumed that the amount of evaporation was the same in all cases, as the time was the same in all the tests and the temperature practically constant. But at the same time it must be granted that there will probably be some error, owing to the different consistency of the specimens and other unavoidable irregularities.

On account of this, it is not well, in drawing conclusions, to lay much stress on the amount of water absorbed during the test as affecting the quality of the concrete in question; that is to say, when the amount of water absorbed was only a few grams and the specimen showed no sign of leaking. In fact, on leaving the specimens under pressure for 24 hours, it was found that in almost every case the specimen was lighter after the test than before, evidently owing to evaporation.

The temperature of the room was about 50° F. and remained nearly constant and the air was far from dry, there being several tanks of water in the room continually.

The results show a decided advantage for the specimens made from cement No. 1, both as regards the amount of water absorbed during the test and ability to withstand the highest pressure witnout sign of leakage. It also appears more plainly from the fact that cement No. 1 was procured in the open market, while No. 2 was sent by the manufacturers, who knew the object of its use. However, No. 2 was said to be more than two years old, and thus might not have been a first-rate sample.

The specimens which showed no leak in two hours were left under pressure for 24 hours, and at the end of that time no leak appeared in any case.

As a pressure of 80 lbs. per sq. in. is equivalent to a head of 184 ft. and the thickness of the concrete was only 5 ins., it is perfectly safe to conclude that a concrete of the proportions of any of the specimens which did not leak under 80 lbs. pressure would be practically impermeable under any conditions ordinarily found in practice.

Of the various mixtures we may safely choose either 1 : 2 : 4 or 1 : 2.5 : 4, on account of their simplicity and the ease with which they may be proportioned, either for hand or machine mixing. In extreme cases, however, it might be advisable to use one of the richer mixtures.

## ANNUAL CONVENTION OF THE ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.

The 21st annual convention was held at Chicago, June 18, 19, the headquarters and place of meeting being at the Stratford Hotel. The meeting was called to order at 10:30 a. m., June 18, by the President, Mr. C. F. Annett (Illinois Central R. R.), of Chicago. No formal addresses were made, but the business proceedings were started at once. The report of the Secretary and Treasurer, Mr. P. W. Drew (Wisconsin Central Ry.) of Milwaukee, showed a membership of about 93, and a cash balance of $59. The question of the place of the next meeting was then taken up, but in view of the trouble over the matter of passes, which necessitated changing the place of meeting this year from Boston to Chicago, it was voted to appoint a committee to take the matter up later with the passenger associations. This committee will report to the Executive Committee, which is empowered to select the place of meeting. There were only a few papers presented, but all were listened to with attention and were followed by extended discussions of particular interest.

### TYPEWRITTEN TRAIN ORDERS.

At the afternoon meeting Mr. W. J. Holton (Chicago & Western Indiana R. R.) read a paper on this subject, showing the advantages of train orders written on the typewriter instead of by pen and ink or stylus. Many railways now require telegraph operators to be typewriters, and these men are really of more value to the company, not only on account of their being typewriters but because their work does not deteriorate. After many years of constant hand writing, men become less reliable and are subject to writers' camp. The form of train order may be changed to make it more convenient for machine work, but the ordinary form of order is generally used for the machine. There is very little liability of a man striking the wrong key. Operators generally supply their own machines, but he favored their supply by the railway. Several railways are now using typewritten train orders, and they are much appreciated by the enginemen and conductors on account of their legibility. Men who study to be operators now generally learn to use the machine, so that it is not difficult to get men to work on this system. They can follow the train dispatcher's dictation on the machine even better and more rapidly than with a pen or stylus.

In the discussion, Mr. G. C. Kinsman (Wabash R. R.) stated that he never has any trouble with typewritten orders. He uses a special carbon which makes a copy that will not rub off even when wet. Mr. W. W. Ryder (C., B. & Q. Ry.) referred to the adoption of typewriting machines by the telegraph companies, which at first refused to allow their use, and he thought the same experience would result with the railways. Several members stated that operators on their roads use typewriters, but not for train orders. A resolution was passed expressing it as the sense of the meeting that it is advisable to use typewritten train orders, and a committee was appointed to discuss the matter with the train-order committee of the American Railway Association.

### THE TELEPHONE IN RAILWAY SERVICE.

A description of a special telephone and telegraph system in use between Milwaukee and Minneapolis and other points, was then given by Mr. U. J. Fry (C., M. & St. P. Ry.), referring especially to impedance coils and their effects upon telephone circuits. This led to considerable discussion on telephone circuits parallel with telegraph circuits, and troubles incident thereto. The discussion was continued on Thursday morning, when Mr. C. F. Annett (Illinois Central R. R.) described the extensive telephone system on that railway. At present this covers an aggregate of about 1,000 miles of line (2,000 miles of copper wire), and it will eventually aggregate about 1,950 miles, extending over all the main lines, from Chicago to New Orleans, Chicago to Omaha, and Louisville to Fulton. It is used by all departments of the service and is very satisfactory. Mr. L. B. Foley (D., L. & W. Ry.) stated that his road has had very satisfactory results from its telephone service, the wires being carried on the same poles with the telegraph wires. The longest circuit is from New York to Elmira, 263 miles. Mr. Miller (C. & A. R. R.) has had experience with 126 miles of copper metallic circuit, but the troubles and interruptions were so numerous that it was not considered satisfactory, and its use for long-distance work was abandoned. Mr. B. Bidwell spoke of a German telephone system which can be operated on warships even when the guns are being fired, and he suggested that similar apparatus might be used wherever telephone service was interfered with by noise.

Mr. Jacoby (Lehigh Valley R. R.) thought many of the troubles could be avoided by anticipating them in proper construction. His road has had a circuit of about 90 miles in operation for two years, using two of the telegraph wires. This was so satisfactory that the company has felt warranted in extending the system 100 miles, using independent wires in this case. Test stations are arranged 5 to 10 miles apart, so that line troubles can be quickly located, the maximum delay being two hours. If a road has ten wires, it may arrange them in pairs, with four pair for telegraph and one for telephone service. Then in case of trouble, the use of suitable switches will enable the telephone circuit to be changed to another circuit that is in working condition. The road now has the telephone system in service between New York and Wilkesbarre, 176 miles, and will eventually extend it to Buffalo.

This same subject was again take up on Friday morning, June 20, when Mr. O. C. Greene (Northern Pacific Ry.) described a special impedance coil used by him on composite telephone and telegraph circuits. On one of these circuits the only disturbance comes from the high-tension transmission lines of the Snoqualmie Falls power system, built on a right of way parallel to the railway. Transposition at every fifth or sixth pole will practically kill the induction. Mr. Jacoby (Lehigh Valley R. R.) has had trouble from high-tension lines paralleling a telephone circuit for a short distance. As these high-tension wires are not uniformly strung and are on poles of different heights (at road crossings, etc.), it is practically impossible to entirely prevent induction noises. Twisting the wires or transposition at every few poles will almost prevent the trouble, but would be troublesome and expensive on long lines. The direct-current 500-volt electric railway circuits cause very little trouble to telephone service, but 20,000-volt alternating currents form a serious problem. He would prefer to have the telephone and high-tension wires on the same poles where possible, so that they could be kept equidistant; this, with regular transposition, would kill induction. He uses a rheostat to maintain a uniform ohmic resistance of coil and line (within ½-ohm); the rheostat allows of adjustment to suit varying conditions, which a fixed resistance does not.

### TELEPHONING FROM MOVING TRAINS.

On Thursday morning, Mr. Benson Bidwell (Grand Rapids, Mich.) described his system of telephoning between trains or between a train and the dispatcher or superintendent. The two wires are to be strung on poles, and are about 6 ft. from the rails and 20 ft. abo[ve] car has a side-bearing trolley pole, with two on each wire. The wires may be placed ov[er] of the track, or they may be replaced by ro[ds] ground along the ties, if preferred. The sys[tem] yet been tried on a steam railway, but has [been] an electric railway at Muskegon, Mich. A[t the] ment of this system Mr. Bidwell suggested telephoning from trains to cities for the c[on]venience of passengers. The wires for this would be in[stalled] the train dispatching wires, and the system [would] source of revenue to the railways. Mr. Jac[oby] Valley R. R.) thought there would be difficu[lty] coming the objections of the track departm[ent] above or along the track. Mr. P. W. Drew Central Ry.) thought the strongest objection [to] the liability of the trolley to jump off the wi[re]. Mr. Bidwell has a special arrangement to prevent [this]. A committee was appointed to look into the Bidw[ell] system.

On Friday morning, Mr. C. S. Rhoads (C., [St.] L. Ry.) presented a brief report from the Com[mittee] on Code. Mr. P. W. Drew (Wisconsin Central Ry.) [said] that it was important to try and get some reduc[tion in] the present enormous superfluity of words that occur [in] daily telegraph work. It was voted that a copy of the report should be submitted to the American Railway Association.

After the conclusion of the discussion on the use of the telephone in railway service, already noted, Mr. Jacoby (Lehigh Valley Ry.) brought up for discussion the subject of

### OVERHEAD WIRE CROSSINGS.

There are numerous crossings of telephone and other electric wires over the railway wires, where, through defective construction, a very slight storm will bring down the wires and cause trouble to the railway service. In the east, many railways refuse to allow overhead crossings of wires, except at highways, on account of the troubles which result. At highways, they require the crossing company to put up guard wires or otherwise protect the railway company's wires. Mr. Kinsman stated that the Wabash Ry. requires all telephone, telegraph or electric light wires crossing the road except at highways to be laid underground (preferably in iron pipe), and endeavors to have them laid underground, also at roads and streets. Mr. Rhoads (C., C., C. & St. L. Ry.) referred to the Michigan and Ohio laws on this point, requiring the use of double crossarms and guard wires for lines crossing the railways; Indiana has a somewhat similar law, but it is less specific. On his road, crossing wires are cut at once of they are considered unsafe. Mr. Drew explained that the Michigan law also designates the maximum span allowable at crossings. It was voted that the Secretary should secure copies of the Michigan and other State laws on this point, to be printed in the report of the convention.

### ARC LIGHTS AT ROAD CROSSINGS.

Mr. Kinsman (Wabash R. R.) referred to the fact that many municipalities require railways to light grade crossings by arc lights over the crossings, a practice which involves considerable expense. In Ohio the legislature has passed a bill prohibiting the use of such lights. This action resulted from a petition from the Brotherhood of Locomotive Engineers, pointing out that these lights shining in the eyes of enginemen interfered with the proper view of the track and signals, and were consequently a source of danger to passengers.

### OFFICERS.

The following officers were elected for the ensuing year: President, J. H. Jacoby, Lehigh Valley R. R., South Bethlehem, Pa.; Vice-President, W. J. Holton, Chicago & Western Indiana R. R., Chicago, Ill.; Secretary and Treasurer, P. W. Drew, Wisconsin Central Ry., Milwaukee, Wis.

## THE PENDING RIVER AND HARBOR BILL.

Hon. T. E. Burton, Chairman of the House Committee on Rivers and Harbors, in a recent speech before the House of Representatives, defended the pending River and Harbor appropriation bill, and maintained that the bill would confer inestimable benefits upon the country. It is a common impression that the bill appropriates $60,000,000 to be expended in one year. This is not the case; only $24,000,000 of the amount appropriated is to be expended in the year ending June 30, 1903, and many years would elapse before the total amount authorized in the bill would be spent. The Act of 1896, for example, authorized the expenditure of $59,616,404; yet of this amount $12,186,801 is still unexpended. Further, of the $24,000,000 appropriated for 1903, in the natural course of events, not more than $19,000,000 can be used by June 30, 1903, the end of the fiscal year.

The second misapprehension is that this bill carries much larger amounts than previous bills. Mr. Burton refutes this by a tabular statement of appropriations for the years 1879-1902, inclusive. These show that the largest appropriation for the

...year was $25,136,295 voted for the year 18... while the similar appropriations of 1888 also ex... the amounts of 1902. He also points out that ...propriations for rivers and harbors are not ...ing faster than other appropriations by the ...ernment, but, in fact, are proportionately ...less. For the period 1879-1902 the growth in ...unts for rivers and harbors was 42%, or, ... 1900-01, the largest in its history, it was ... for postoffices, for the period 1879-1902, the ... was 272%; for the navy, 451%; for the ... 352%, and for fortifications, a jump from ... in 1879 to $7,364,011 in 1902, a growth of ... The total amount appropriated in the ... four years for rivers and harbors was about ...,000, as compared with $247,000,000 for the ... alone.

... Burton says that very little is now being ...ended upon minor streams, although other bills ...ast years have carried an inordinate amount ... the improvement of such streams. While a ...siderable number of streams of moderate ...affic are included in the bill, the total sum allotted to them is a very small part of the total expenditure provided for. To illustrate this: There are mentioned in this bill 35 streams, each of which carries less than 50,000 tons of freight annually. The total provided for these streams, however, is only $214,000, and the expending of this will spread over two years. There are also 24 streams having 50,000 to 100,000 tons annual traffic each, and for these $202,000 is to be spent. The annual total volume of commerce on the 35 streams is 619,105 tons; on the 24 larger streams it is 1,671,263 tons. Thus the expenditure of $417,000 in two years, or $208,500 in one year, provides for an annual traffic of 2,290,368 tons, at a cost to the government of between 8 and 10 cents per ton.

Of the $60,000,000 included in this bill, $50,000,000 is appropriated for great projects, including the improvement of the South West Pass of the Mississippi River, the St. Mary's River, and for the Mississippi River itself $12,000,000. The bill also provides for an international commission on lake levels, which is to consider the whole subject of the levels of the great lakes and all waters finding their outlet through the St. Lawrence. The advisability of building a dam at the foot of Lake Erie is to be considered by this commission.

Perhaps the most important clause in the bill is one providing for a board of five engineers which shall receive all projects examined by the local engineers and advise Congress as to their acceptance or rejection. A similar provision was included in the last River and Harbor bill, which failed of passage.

## ATLANTIC CITY MEETING OF THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

The fifth annual summer convention of the American Society of Heating and Ventilating Engineers was held at the Hotel Rudolf, in Atlantic City, on Monday, June 16. The attendance was remarkably large for the midsummer meeting of such a small society, about 90 members and guests being registered as present. The reports of the Secretary and Treasurer showed that the society is in a flourishing condition—increasing in membership, out of debt, and a little money in the treasury. Two sessions were held—morning and afternoon—the afternoon being devoted to yatching and other recreations. Only two papers were read and discussed. The first was entitled "Cooling an Auditorium by the Use of Ice," by John J. Harris. It briefly described a successful experiment in the Scranton high school, on the occasion of the commencement exercises in June, 1901. The inside temperature was maintained at 76° F., while the outside temperature was 90°. The room contained about 1,400 persons. It is ventilated by pressure and exhaust fans. The air was passed over racks containing 8 tons of ice. The humidity was at all times kept below the saturation point. The experiment was repeated at the commencement held during this present month, with similar results. The paper brought out considerable discussion, in which it was shown that there is a great lack of information as to the conditions under which cooling of auditoriums by ice can be made a success. It was pointed out that while such an experiment might be successful in Scranton, with its dry atmosphere, it might fail in New York on account of the extreme humidity.

The second paper was entitled "A Time Limit and Dry Walls Necessary in Testing a Heating Plant," by John Goomly. This paper had reference to the time-honored but troublesome requirement of heating specifications that the apparatus shall be capable of heating the rooms to 70° F. in zero weather. It gave an account of tests of a steam heating system in a new building. With an outside temperature of 20° F. and no plaster on the walls it was easy to raise 10 lbs. of steam; but as soon as wet plaster was on the walls no steam pressure whatever could be obtained, although the fire was driven as hard as possible, and the draft excellent. After several weeks of running to dry the plaster, tests of temperature were made on two successive days when the outside temperature ranged from 50 to 62°. Very much higher temperatures in the several rooms were obtained on the second day than on the first. It was shown that no satisfactory test of a heating system can be made while the walls are wet and cold, and it is a very different thing to obtain a temperature of 70° with the weather outside at 0°, when the test is begun with damp and cold walls, than to maintain this inside temperature after the building has been heated and the walls dried. The discussion only emphasized the points made in the paper.

Much of the time of the two sessions was taken in discussing plans for the future of the society. It is proposed to hold a convention of heating and ventilating engineers at St. Louis in 1904, during the World's Fair, to which foreign engineers will be invited, and the suggestion was made that a special set of papers be prepared and presented in advance of the convention, treating of the existing state of the art in the different branches of the heating and ventilating industry, with especial reference to formulating rules for proportioning apparatus. A committee is to be appointed to report at the winter meeting on all the suggestions. The discussion of the several papers and topics was well sustained, and the meeting was a highly satisfactory one, notwithstanding the failure to obtain some technical papers which had been announced.

## GOVERNMENT VS. PRIVATE CONTROL OF IRRIGATION WORKS IN THE ARID REGIONS.

In a discussion before the American Society of Civil Engineers at the late Washington Convention, Mr. Elwood Mead, Irrigation Expert in the U. S. Department of Agriculture, gave some of the reasons why the government should build and operate certain types of irrigation works.

These classes are the reservoirs located in the channels of streams whose waters are used in irrigation, and diversion works of great magnitude and cost. Reservoirs are a necessity to the largest and best use of the water supply of the arid region. Water must be stored because these streams are high when little water is used and low when water is most needed. When the mountain snows are melting, large volumes of water run to waste, and when the snows are gone the streams shrink to a shadow of their former volume, just when this water is needed for irrigation, or in the month of July. The studies of the government engineers show that Weber River, in Utah, for example, dropped from a flow of 4,588 cu. ft. per second in June to 455 cu. ft. in July. The high water flow of the North Platte in June is 34 times its low water flow in August. In Northern Wyoming, Clear Creek, in June, 1898, had a discharge of 32,000 acre-feet; in July this discharge was less than 12,000 acre-feet. Four-fifths of the streams used in irrigation furnish similar examples.

The construction of the required reservoir could be left to private enterprise were it not for the following reasons: The first reason against private work is embodied in the legal and economic complications over water rights involved. Storage works located in stream channels must receive all the water that comes from above them; they intercept the water at a time when the river is low, and when the whole flow is needed by and legally belongs to those having vested rights on the lower course of the stream. If this reservoir is in private hands, and probably remote from the lands now irrigated, the farmers who need all the flow will hold the reservoir responsible for all shortage in flow, and controversy and litigation will follow. If the works are under public control, the irrigators will be less likely to suspect interference with their rights.

In private hands there is danger that the owners of the works will trade upon the necessities of the farmers and charge high rates for water. But the doctrine of public ownership can be maintained over the stored supply as well as over the natural flow, and monopoly of water would be impossible and its abuses averted.

The construction by the government of large and costly diversion dams and main canals is justified by the fact that the United States owns large tracts of land now practically worthless which could be made habitable, productive and valuable by this outlay. Government ownership carries with it the responsibility to so administer this property as to make it provide the largest possible opportunities for those seeking homes. Individuals and corporations will not undertake the work without the prospect of large profits, and should they undertake it the cost of the land may be placed beyond the means of the poor man. Further, the government derives an indirect return on such investment in the increased taxable wealth of the country, which private enterprises cannot share. Some of these works would be located in one State, while the water would be used in another State, and it is a simpler proposition to construct them under the Federal Government than it is for the States to reach an agreement. Some of the States are too poor to utilize their resources and others, again, are prevented by constitutional restrictions. But the Federal power can secure the needed funds by selling public lands, and can thus build the works without burdening the taxpayers, while the States have no such resources and cannot even tax the public lands, which in some of the arid States constitute 80% of the total area.

There are some vexed questions to be settled, however, relating to the respective spheres of State and National authority over the control of streams used in irrigation, and we are now beginning to realize that the framing of water laws is among our most vital and perplexing problems. In the case of streams of the arid regions flowing into navigable streams, is the steamboat below or the orchard above to have first claim on the mountain snows? And how are we to reconcile the claims of interstate streams when on one side of the boundary the doctrine of appropriation prevails, while on the other bank the common law doctrine of riparian rights holds? These questions must be sooner or later settled by Congress or the U. S. Supreme Court.

EXPERIMENTS WITH SEDIMENTATION are to be made at the settling basins of the St. Louis water-works under the direction of Mr. Edw. Flad, M. Am. Soc. C. E., Water Commissioner. Mr. Flad has kindly sent to us the following account of the experiments:

We have six basins which are being operated on the continuous flow plan, the basins being arranged in parallel. That is, one-sixth of the water enters each of the basins at one end and a similar quantity is drawn off continuously at the other end. We are providing siphons between three of the basins and expect to operate said three basins in series, whereas the other three will continue to be operated in parallel, each set of three taking one-half of the supply. We are constructing a hydraulic dredge which, consisting essentially of a centrifugal pump, electrically driven, placed upon a barge floating in the basin, with suction pipe extending to the bottom of the basin and floating discharge pipe. By means of this dredge we expect to be able to pump the deposit out of the basins while they are in use.

## BOOK REVIEWS.

THE PRINCIPLES OF SANITARY SCIENCE AND THE PUBLIC HEALTH.—With Special Reference to the Causation and Prevention of Infectious Diseases. By William T. Sedgwick, Ph. D., Professor of Biology and Lecturer on Sanitary Science and the Public Health in the Massachusetts Institute of Technology; Sometime Biologist to the State Board of Health of Massachusetts. New York: The Macmillan Co. Cloth; 6 × 9 ins.; pp. 368; illustrated. $3.

Of the general character of this book we have spoken in the editorial pages of this issue. It may be added that the volume is the outgrowth of lectures to students at the Massachusetts Institute of Technology. The author first discusses health and disease, including old age, as a cause of death, ancient and modern theories of the cause of disease, the rise and influence of bacteriology, and the sanitary aspects of the struggle for existence. Part II. is devoted to the dissemination and control of infection and contagion. Dirt, sewage, water, ice, milk, and certain uncooked foods, as affecting public sanitation, are each considered in turn. Various means of preventing the spread of disease, like aseptic surgery, vaccination, refrigeration and disinfection, are next taken up. Finally, there is a most useful and much-needed chapter "On Some Popular Beliefs as to Certain Special and Peculiar Causes of Disease." In this chapter such topics as sewer gas, well water, bad smells, inherited tuberculosis and ice-cream poisoning are discussed in a rational manner. A few well-chosen illustrations are included. The typography and general make-up of the book is in pleasing contrast to that of many scientific treatises, and there is a serviceable index. We hope the book will have the wide sale that it merits.

# ENGINEERING NEWS
AND
## AMERICAN RAILWAY JOURNAL.

*Entered at the New York Post-Office as Second-Class Matter.*
*Published every Thursday*
*at St. Paul Building, 220 Broadway, New York, by*
*THE ENGINEERING NEWS PUBLISHING COMPANY*

GEO. H. FROST, . . . . . PRESIDENT.
D. McN. STAUFFER, . . . . . VICE-PRESIDENT.
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ALFRED E. KORNFELD, New York,
M. C. ROBBINS, Chicago,
S. B. READ, Boston. } ADVERTISING REPRESENTATIVES.

PUBLICATION OFFICE, 220 BROADWAY, NEW YORK.
CHICAGO OFFICE, 1636 MONADNOCK BLOCK.
BOSTON OFFICE, 170 SUMMER ST.
CLEVELAND OFFICE, OSBORN BUILDING.

FOREIGN AGENTS.

C. MITCHELL & Co, Snow Hill, Holborn Viaduct, LONDON.
RUDOLF MOSSE, BERLIN and HAMBURG, GERMANY.
JOHN F. JONES, & CIE. 31 Rue de Faubourg Montmartre, PARIS.

*SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; 6 months, $2.50; 2 months, $1.00. To all other countries in the Postal Union: Regular Edition, One Year, $7.60 (31 shillings); Thin Paper Edition, One Year, $6.31 (26 shillings). SINGLE COPIES of any number in current Volume, 15 cents.*

*In requesting change of mailing address, state BOTH old and new address; notice of change should reach us by Tuesday to be effective for the issue of the current week. The number on the address label of each paper indicates when subscription expires, the last figure indicating the year and the one or two preceding figures the week of that year; for instance, the number 322 means that subscription is paid to the 32d week (that is the issue of Aug. 7) of the year 1902; the change of these figures is the only receipt, unless one is sent by special request.*

*ADVERTISING RATES: 20 cents a line. "Want" and "For Sale" notices, special rates, see page XXIV-XXIX. New copy for standing advertisements should be received one week in advance of publication; new advertisements, Monday morning. The pages containing "Want," "For Sale" and "Proposal" advertisements are held open until Wednesday noon.*


Two elevator accidents in one day in New York city recently, ought to call general attention, it seems to us, to the need of greater care in the inspection and maintenance of elevator machinery as well as in its design. Of the two accidents referred to, on June 18, one occurred in the department store of R. H. Macy, where a car containing fourteen persons fell five stories. The other occurred in a hospital where an elevator car started of itself while a patient on a stretcher was being moved off the car, the elevator attendant carrying one end of the stretcher. Before he could stop the car the patient was crushed against the ceiling of the floor above.

Only two days before, on June 16, as recorded in our last week's issue, an old-fashioned belt-driven elevator in a New York clothing factory, fell or ran down six stories, seriously injuring the employees with which it was crowded.

What can be done to lessen this record of casualty? It seems to us that the first thing to be done is to establish expert investigation of such accidents, to the end that their cause may be publicly known. Every such accident, almost, carries or might carry some lesson to those engaged in the design, manufacture or operation of elevators, and it is important that this lesson should be discovered and made known.

At present the fear of damage suits causes everyone who can give information concerning any such accident to shut up like an oyster, or give misleading information when any inquiries are made. We have often heard engineering journals criticised because they did not give more space to descriptions of accidents and of the devices that fail, as well as those which succeed. Such critics overlook the extreme difficulty of obtaining any such information from any reliable sources. Even if this difficulty did not exist, a technical journal cannot undertake, save in exceptional instances, anything like a systematic expert investigation of accidents. To do so on even a small scale would absorb time of its staff which cannot be spared from other duties.

There is good reason to believe that elevator accidents are on the increase. Machinery which worked well when new is becoming old and worn. In the valuable paper on "Elevator Safeties," published in our issue of June 12, it was pointed out how important a factor is wear of the jaws of the safety grips in influencing their operation. There is, unfortunately, only too good reason to believe that a large proportion of the elevators in service are equipped with safety appliances which would prove unsafe if called upon to perform their duty. Such defects as these, in a matter so closely affecting the public safety, it ought to be the duty of some competent public authority to discover and remedy. Systems of state and municipal elevator inspection are indeed in force; but they work too much in the dark. The Boards charged with such duties might well be empowered to make investigations of all elevator accidents.

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What is to be the future of the American Water-Works Association? This is a question that has been asked with more and more frequency for a number of years past. The total membership is now 320, the same as a year ago, and 73 less than in 1898. The interest of the members appears to be declining, and the character of the proceedings as a whole is certainly not what it was a few years since, much less what should well be expected from a national association of water-works managers. Comparisons, we know, are odious, yet we cannot refrain from mentioning the fact that the New England Water-Works Association had 555 members on Jan. 1 last. This organization, a large proportion of whose members live outside New England, holds monthly meetings during all but the Summer season of the year; publishes a high-grade quarterly Journal; and conducts its affairs in a business-like manner, having recently adopted a new constitution modeled on the broad general lines common to the great national engineering societies. The American Water-Works Association holds only one meeting a year. It rarely makes its program public until the convention opens, while to a large proportion of the members the social features predominate so largely as to weaken the sessions devoted to the reading of papers. Moreover, nearly every year one or more papers are read before it which are so full of pseudo-scientific absurdities and vagaries as to bring discredit on the organization.

Besides the effect of the far greater attractions of the New England Water-Works Association, already mentioned, the American Association has doubtless been weakened by the formation of the American Society of Municipal Improvements, which, though small in numbers, is doing excellent work, and by the Central States Water-Works Association, which seems to meet the local needs of its tributary states. That there are too many associations in the water-works field, nearly every one feels; and it remains to be seen which among them will be the first to succumb in the struggle for the survival of the fittest.

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The use of the telephone in railway service was the principal subject of discussion at the convention of the Association of Railway Telegraph Superintendents which was held in Chicago last week. The subject was discussed from various points of view, as will be seen by the report of the proceedings given in another column. It was shown that the Illinois Central R. R. has in service telephone circuits over portions of its system aggregating 1,000 miles in length, and is steadily extending the lines so that eventually they will connect all the main terminal points. Other individual railways have circuits from 100 to 250 miles in length. The greater facility and flexibility of communication, and the advantages due to the fact that the communication is [illegible] nature of a direct personal conversation, [illegible] among the principal advantages of the telephone [illegible] the telegraph. There seems to be not the [illegible] idea that the telephone will supersede [illegible] graph, but the general opinion is that it [illegible] extremely valuable addition to the facilities [illegible] railway operating service, and that its use [illegible] continue to extend very rapidly. Comparatively little was said as to its use in train dispatching, for which it is employed in some very busy and complicated situations, but it was shown that [illegible] able telephone instruments on trains would be very valuable in the event of train accidents, as they would enable warning to be sent and help called for much more rapidly than by any other means. The telephone would also be of use [illegible] has been used, in handling traffic at points where one track has been blocked by an accident. Although anybody can use the telephone, the members did not appear to think that its introduction would lead to the employment of operators at less pay than that given to telegraph operators, for the reason that the same responsibilities rest upon the operators in either case. In many cases the composite system is employed, in which the same wires are used for both telegraph and telephone service, but most roads appear to be introducing independent telephone circuits, with two copper wires. One of the greatest troubles at the present time arises from noises due to induction (particularly where high-tension transmission lines parallel the telephone lines), and next to these come interruptions due to line failures and the delay in locating them. The Lehigh Valley R. R., however, places test stations at intervals of 5 to 10 miles, by which means the failures are very soon located. There is, of course, more or less objection to and opposition to the innovation, but there is every indication of a very extensive and rapid development in the use of the telephone in railway service. In this connection reference may be made to the use of the telephone for train dispatching and for general purposes of communication on large systems of electric interurban railways. On some of these lines train orders are transmitted directly from the dispatcher to the conductors by means of telephones on the cars, temporary connection being made with the wires at passing sidings.

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In the discussion at the convention of the American Institute of Electrical Engineers last week, on the comparative economy of steam and electric traction for suburban trains, it was practically admitted that the electric motor could show no saving in operating expense over the steam locomotive that would offset its much greater first cost. Mr. Frank J. Sprague, however, thought that the increased safety of electrical operation was sufficient reason why it should be installed.

What we would like to learn, is where Mr. Sprague finds the increased safety in electric operation of which he so confidently speaks. What proof of such safety can he offer?—for the burden of proof is certainly upon those who would change the existing system.

As an example of this alleged safety, the New York daily papers of Monday, June 23d, contain the record of four accidents on electric railways in Greater New York, occurring on the previous day. We may briefly summarize them as follows:

(1) Five lines of the Metropolitan system—the Broadway, Sixth, Seventh and Eighth Ave., and 59th St.—were tied up for half an hour during the evening by the failure of current. The cause ascribed in the newspapers is the blowing out of a fuse in the main power house. (2) A controller stuck on an Amsterdam Ave. car, and the motorman was unable to stop it. Apparently he was rattled when he found the controller handle could not be moved, and forgot to open the switch to cut off current from the car entirely. The car ran for half a mile at high speed and finally went off the track; two persons went to the hospital with broken ribs. (3) A Myrtle Ave. car in Brooklyn was enveloped in flames from a "blowing fuse," according to newspaper reports. Half a dozen

persons received burns; one girl of 15 was so badly burned as to endanger her life. The fire department had to be called out to extinguish the blaze. (4) A crowded train car was running on the Coney Island route at 11 p. m., when it passed a pile of ties so close beside the tracks that eight men who stood on the steps were struck by the ties and injured.

The same paper which records the above list of accidents in New York also contains the news of a collision of two electric trains near Milan, Italy, on June 21, in which 49 persons were injured.

Of course this accident as well as the fourth one described above, might have occurred on a steam road, but the exact point we wish to emphasize is that accidents by collision or derailment, or a great number of other causes, are precisely as likely to occur on an electric railway as on a steam road given equal care in operating. With the hit or miss systems of operation which are so often found on electric roads, the passenger on an electric road stands much more risk of death or injury. In addition to this, as the above three accidents illustrate, the electric system has troubles and dangers of its own, and very serious dangers, too. Until they are in some degree removed it is little less than absurd to talk of the increased safety of electric locomotion over steam.

## THE PRINCIPLES OF SANITARY SCIENCE.

One of the most striking things in sanitary work of the present day is the vast amount of misdirected energy displayed on every hand. A great public awakening to the importance of sanitation has taken place and an army of health officers has been put in the field to combat the various causes of disease and death. The daily press and the public have taken up the warfare, and State legislatures and the courts are reflecting an aroused public opinion.

With all this activity along lines so new, it is not strange that confusion and conflict of opinion often exist and that as a consequence public health protective work is frequently found proceeding along wrong lines. The results of such work being disappointing if not disastrous, public confidence in the efficacy of all sanitation is shaken. All this tends on the one hand toward panic, when an epidemic of contagious disease threatens, and on the other hand toward neglect of needed precautions, because other precautions once held important are now found unnecessary. As a single example, but one that has been, and still is, a widespread source of misdirected energy, we may mention the precautions often taken to exclude so-called sewer gas from houses. Foul air from sewers, like that from any other source, is doubtless to be guarded against, but in thousands of instances where disease has been ascribed to "sewer gas," the water or milk supply, and not defective plumbing has been the real source of infection. We may admit, indeed, that the plumbing in many of these instances has been sadly defective, and perhaps it has sometimes rendered the victims more liable to yield when exposed to infection from other sources; yet, in nine cases out of ten, we may charge the defects in the plumbing to the misdirected energy which provided a complicated and expensive system of traps and vent pipes to exclude a supposed deadly poisonous gas, instead of putting the same or less expense into a simpler design, with better material and workmanship.

To aid in remedying the evils just outlined, there has long been needed a clear cut statement from an authoritative source, of the foundation principles of sanitary science. True, there are numerous manuals and hand-books of sanitation, but, as a rule, these attempt either too much or too little, and, in many instances they perpetuate the errors of the past. Besides this, such books usually deal more with the practice than with the theory of sanitation.

It is not strange that such defects should exist during a period when the art of sanitation is subject to daily modifications and when the formulation of some of its principles has scarcely yet been attempted; but, nevertheless, the need of a comprehensive and reliable elucidation of sanitary principles has for some time been imperative.

A book which promises to meet this demand has just appeared. It is written in a clear, interesting and convincing manner that particularly suits it for all classes of seekers after sanitary truth. Its title is "The Principles of Sanitary Science and Public Health," and its author is Prof. Wm. T. Sedgwick, of the Massachusetts Institute of Technology. Those who have followed Professor Sedgwick's work in sanitary biology, and in the study and control of epidemics, or have listened to his lectures on various phases of sanitation need no assurance of the value of this work. To others we may say that the volume is a comprehensive yet conservative presentation of principles, which, if fully grasped and effectively applied, would save many millions of dollars, alleviate inexpressible pain and misery, extend the span of human life and uplift the individual, the municipality and the nation.

An outline of the contents of Professor Sedgwick's work is given elsewhere in this issue. His general attitude towards the subject in hand may best be conveyed by a glance at his preface.

In view, the author says, of the "innumerable municipal, medical, domestic, public and private sanitary safeguards which have already" arisen from the use of the microscope and a better understanding of sanitary science,

> it is hard to realize that our not very remote ancestors regarded disease as an insoluble mystery, an inscrutable visitation of Divine Providence or as the penalty and consequence of sin. But if disease be disturbance of a physical mechanism, and due to the fact that the mechanism is made of poor materials, or of good materials badly put together, or that it is badly operated, or that it is interfered with by unfavorable environmental conditions, it becomes easy to comprehend, at least approximately, the causes of diseases, and in many cases to remove or forestall them. It is precisely this which the science and art of hygiene seek to do, namely, to comprehend the nature of the human body and its diseases, in order as far as possible to prevent the latter. Hygiene is the science and art of the conservation and improvement of normal living, the prevention not merely of premature death but of abnormal life; and sanitary science or hygiology, is simply the body of scientific doctrine, or the principles, underlying the sanitary arts.
>
> The time has not yet come for a scientific treatise on the whole subject of hygiene. The application of many of the results of experimental science to the welfare of man, extensive and valuable though they are, must still wait until their relations to everyday life become clearer. Climatology, clothing, warming and ventilation, foods and feeding are subjects undoubtedly of the very first importance, but not as yet reducible in their relation to human life to simple scientific terms. It is otherwise, however, with an important class of diseases proceeding from the controllable environment and known as "communicable," or "infectious." In principle, at least, these are now well understood and capable of being scientifically dealt with. Their causes are known, as are also the sources in which they originate, and the vehicles by which they are transported. Their characteristic operations and effects are rapidly becoming familiar everyday facts. Their control, therefore, in theory at least, becomes easy and in a broad sense a problem of engineering, which subject has been defined as the scientific control and use of the forces and materials of nature for the benefit of man. So much, at least, of medical or sanitary engineering rests upon a sound scientific basis, and for this the term "sanitary science" as distinguished from "hygiene" may conveniently be employed,

Our readers will be interested to note that the author believes the control of communicable diseases to be "in a broad sense a problem of engineering." This idea is already gaining recognition and with its practical application we find a marked diminution in certain diseases. As examples we may cite the decrease of typhoid fever in the cities of Lawrence and Albany since the introduction of filtered water, and in Newark and Jersey City since a water supply from a relatively pure source was introduced.

But while the dangers of impure water are becoming fairly well appreciated in many sections, the need for a more sanitary milk supply, the control or prevention of epidemics through proper isolation (not shot-gun quarantine) of patients, the evils resulting from poor ventilation and a score of other sanitary principles are still too frequently ignored. A campaign is made against alleged sewer gas or against an ill-smelling but otherwise harmless heap of garbage, whereas, as already indicated, the milk or water supply are many times more likely to spread disease in the community. Fortunately a few of our technical and medical schools are at last giving their students systematic instruction in sanitation; and here and there a local board of health is making use of the services of the men thus trained.

On the whole, the engineering profession has been quicker than the medical profession to grasp the principles of sanitary science and in many lines it will doubtless continue to be the leader in this field. Physicians, however, are doing better than formerly, and this is fortunate since these men, like public school teachers, have almost unlimited opportunities to educate the public in matters of this sort. The New Jersey Sanitary Association has for many years included engineers, doctors and school principals in its membership. The State Board of Health of Michigan holds several popular sanitary conferences in different parts of the State each year, and issues sanitary bulletins for teachers. The Ohio conference of public health officers has recently been formally extended to embrace school superintendents.

The laws of many if not most of the States stipulate in most carefully framed language that there shall be a certain amount of instruction in hygiene in the common schools. Unfortunately this statute has generally been utilized merely to compel the teaching of total abstinence, and the most inexcusable untruths have been set forth under the guise of science—another example of misdirected energy.

These laws relating to the teaching of temperance in the common schools serve to illustrate, also, the fact that in order to have wise laws, wisely enforced, an intelligent public opinion must be behind the law. We may appropriately therefore, repeat in conclusion the words of Lord Derby quoted by Prof. Sedgwick, in his "preface": "Sanitary instruction is even more important than sanitary legislation."

Such instruction Professor Sedgwick's book is eminently fitted to yield to all who choose to profit by its teachings.

## LETTERS TO THE EDITOR.

### A Long-Lived Oak Stick.

Sir: The communication in your issue of May 29, concerning the resistance to decay of oak in cannon wheels calls up the following: In 1840 when General Harrison's campaign for the Presidency was in progress a rally took place at old Fort Meigs, about 10 miles above Toledo, on the Maumee, where Harrison in earlier days had blocked the advance of Proctor. In preparing for the event, which was attended by the settlers for miles around, the enthusiastic supporters of "Tippecanoe" cut an immense oak pole. The night before the day appointed for the "raising," a party of Van Buren adherents got possession of the pole and threw it butt down into the old fort well, said to have been some 75 ft. deep. The small end projected about 15 ft. To-day the well is filled nearly to the top, and out of the earth about 4 ft. of the old pole still projects in a fair state of preservation. The owner of the property, with a public spirit quite unusual, has done all in his power to protect the old fort and its accessories, but he has not been able to guard against the ubiquitous vandal who little by little with ax or hatchet or jack-knife, has cut away the stick until only the 4 ft. remains in sight. Yours truly, C. A. R.

Toledo, O., June 16, 1902.

(We know of nothing in this country in the way of longevity of timber to compare with what can be seen in England, where many historic structures of the half-timbered architecture show oak that is sound after exposure to the weather for centuries.—Ed.)

### Using the Run of the Crusher for Macadam Roads.

Sir: In answer to Mr. H. P. Gillette, in Engineering News of June 12, I do not advocate using the run of the crusher because it saves screening, as it requires very little power to run a screen. I do not offer an extreme claim. For 8-in. macadam bottom course, use everything that goes through a 3-in. screen; for second course use everything that goes through a 2-in. ring, except what goes through a ½-in. ring; use the ½-in. stuff for top dressing. That is the output of the crusher. If a crusher is erected specially for construction on a certain road, what will the erector of the crushing plant do with his 1¼-in. stone, as he has no other market for the stone, except to use it on the road he is constructing? If used in the above manner, both screening and screens can be saved. If the materials are bought from a regular crushed-stone quarry, the output of the crusher is sold cheaper. If, as Mr. Budd specifies, only uniform 1½-in.

stone is to be used for second layer, the crushed stone dealer would not always have a market for his 1¼-in. stone; he would have to store it, and he would be compelled to charge more for stones for road construction, by reason of rejecting a certain size.

In building a macadam road, the advantages of using the output of the crusher are: It will mix the stones more uniformly; it will require much less rolling, as it packs firmer, and it will not ravel. It is claimed that crushed stone of cubical form is better for macadam roads, but the best hard trap-rock does not break in cubical shape; it is more of a wedge shape; and with all different sizes together it will pack down more firmly and will not ravel. Now the point is this, if the "output of a crusher" for constructing a road costs less, is the road, built by using stones all of uniform size sufficiently better to warrant the greater outlay?

William Haelig.

Bound Brook, N. J., June 20, 1902.

(We believe that Mr. Gillette is in substantial agreement with our correspondent's position that the entire output of the crusher can be used to advantage in macadam road construction. Mr. Gillette's letter of June 12 was in opposition to an editorial suggestion in our issue of May 29, (p. 436), that screening the stone from the crusher is perhaps not as necessary or advantageous as engineers have supposed.—Ed.)

### The Arches of Westminster Bridge in London.

Sir: While reading the very interesting article on "Design of a Concrete-Steel Arch Bridge," in your issue of May 8th, I was somewhat taken aback to find that

Westminster Bridge in London is of granite semicircular arches of 76 ft. span, having a thickness at the crown of 7 ft. 7 ins., and at the springing of 14 ft.

Where the author obtained his information with regard to this bridge, I, of course, cannot say, but it is considerably at fault. As a matter of fact, the Westminster Bridge, so familiar to us in London, could not be recognized from the description in the article referred to. Certainly, it has granite piers, and there the similarity ends. The superstructure consists of elliptical arches formed of a combination of cast and wrought iron ribs. There are seven main arches and two smaller ones on the Surrey shore. The spans decrease from 120 ft. in the center to 94 ft. 9 ins. at the ends.

Any further information with regard to this bridge, which is one of the most beautiful on the Thames, may be found in "Thames Bridges," published at the office of "Engineering," London. Yours faithfully,

London, May 24, 1902. J. W. S.

(The author of the paper referred to replies to the above letter as follows.—Ed.)

Sir: My authority for the statement regarding Westminster Bridge was Baker's "Masonry Construction," p. 502-503, under the heading, "Data Concerning Actual Arches," where the following dimensions will be found:

Westminster Bridge, London; Engineer, Labelye; curve of intrados, semicircular; span, 76 ft.; rise, 38 ft.; radius at crown, 38 ft.; thickness at crown, 7.00 ft.; thickness at springing, 14 ft.

I have referred the matter to Professor Baker, who replies that the data concerning Westminster Bridge was taken from "A Treatise on the Arch," by Capt. D. P. Woodbury, Corps of Engineers, U. S. A., Van Nostrand, N. Y., 1859, p. 432, No. 3.

I have since consulted other authorities and find in Howe's "Treatise on Arches," p. 340, the following:

Westminster Bridge, Thames, erected 1747, Engineer Labelye; No. spans, 13; span, 76 ft.; rise, 38 ft.; depth of key, 7.00 ft.; skew, 14 it.; curve, semicircular; spandrels, longitudinal arched voids with side wall; remarks, 2 small arches.

The last remark leads me to believe that the dimensions refer to the two small arches on the Surrey shore, although the authorities that I have found available are by no means clear on the subject. I regret the error but do not consider it a very important one since the comparison will still apply. Very truly yours,

Daniel B. Luten.

The National Bridge Co., Indianapolis, June 19, 1902.

### The Separation of Oil from Condensed Steam.

Sir: Among the letters in your issue of May 29 is a communication from Mr. L. M. Booth, connected with the Industrial Water Co. of New York City, commenting upon the writer's article on the above subject contained in the May 22 issue of Engineering News. Although the writer is not disposed to underrate Mr. Booth's evident experience in this field, he is of the opinion that that gentleman has formed conclusions which do not constitute valid criticisms of the material presented in the above-mentioned paper.

Mr. Booth seems to consider the passage "that actual separation of entrained oil had never been obtained on a large scale" to be unfair to the process advocated by himself and marketed by his company. To the writer's mind, the following paragraph, "Several forms of water purification apparatus, however, separate oil in small quantities, together with other chemical impurities, but do not attempt to purify condensation or oily drips from the engines," applies most directly to the Industrial Water Co.'s process as outlined in Mr. Booth's communication, and the passage before quoted therefore retains entire validity.

The writer's work dealt entirely with separation of oil from emulsion and oily drips, and not from large bodies of liquid constituted perhaps of 99% untainted water and 1% emulsion and oil from engines. The development of an efficient oil separator is, of course, in a somewhat experimental stage, but the separators already on the market have done good work, when properly installed. This, however, is a question only indirectly involved in the oil separation process, and the writer distinctly states that the use of a separator simply reduces the size of the treating tanks, etc., inasmuch as pure condensation need not in that event be mixed with the emulsion and treated simultaneously therewith. Apropos of this point, Mr. Booth states that in the case of two plants cited in his communication it has been found that "the use of lime water may be dispensed with, without impairing the excellence of results," this being possible on account of soft water being available for boiler feed. It is not evident to the writer in what manner the oil from the condensing system is here eliminated. Mr. Booth also regards the introduction of lime water into the boilers as "a questionable procedure," obviously forgetting that this takes place in his own process to a similar extent, inasmuch as the same quantity of coagulator is required to eliminate the oil from one pound of emulsion, regardless of the amount of pure water with which that emulsion may be mixed.

In the writer's opinion, the main point to be kept in view in devising any purification process is that the total condensation from the engine shall be made available for boiler feed (Mr. Booth seems to have entirely overlooked this point), and it was with this object in view that the experimental work was undertaken, with the results recorded. J. R. Bibbins.

Pittsburg, Pa., June 9, 1902.

### A Cheap Cableway.

Sir: I send herewith a sketch of a cheap cableway which may be of interest to some of your readers.

It was designed and successfully operated by our firm in building concrete piers in the Hudson River at Northumberland, N. Y. The piers cross on the rapids, with water from 1 to 3 ft. deep, and the river is here subject to quick rise and fall. The river is about 900 ft. wide at this point, and the river banks are about 20 ft. high. The piers are about 21 ft. high and are used to carry a single-track railway bridge.

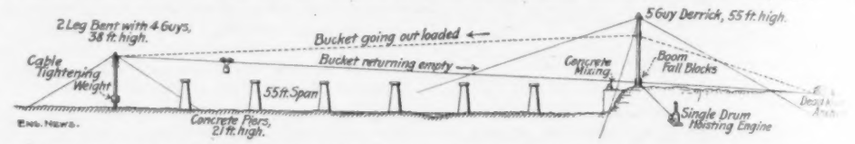
The cableway consisted of a 55-ft. guy derrick without boom, placed near the edge of the bank on the center line of the piers; also a two-leg bent placed in the middle of the river and held in place by four cable guys anchored in the rock of the river bottom.

The cable (¾-in. steel hoisting cable) was stretched from an anchor on shore, about 150 ft. back of the derrick, and it followed the center line of the piers, past the derrick and just clearing it, to the bent in the middle of the river; the latter had a 16-in. cable block fastened to the top of the same. Through this block the cable passed down and was made fast to a weight, consisting of a scale box or skip loaded with concrete until the cable had the required tension, and a pitch of 18 or 20 ft. from center of river to the anchor on shore. The boom fall of the derrick was then hooked onto the cable at the foot of the mast, and by going ahead on the single-drum engine used the cable was hoisted to the mast head. This gave the cable a pitch of 18 or 20 ft. in its length from mast head to top of bent in river, making it a gravity cable in either direction. The carriage on the cable consisted of two 16-in. cable sheaves with iron straps, forming a triangle, with a chain hanging from the bottom point.

The concrete was mixed by hand on a platform at the foot of the mast. When ready for operation the chain on the carrier was hooked to the bucket of concrete (5 cu. ft.) and the engine was started; this raised the cable as well as the bucket and the latter would at once start on its trip to the pier; the piers furtherest away being built first. The speed was governed by the height to which the cable was raised, and as the bucket approached the dumping point the engine was slacked off, or the cable was leveled. The bucket was dumped by a man standing on a staging erected on the form for the pier. By slacking away at the engine the cable would again pitch towards the shore and the bucket now ran down the [illegible] back to the concrete platform; the speed being [illegible] as before by leveling the cable. By using extra [illegible] of cable the bucket would run from platform to [illegible] or 450 ft., in 35 cesonds and return in about [illegible] length of time.

When the piers were completed to the cent[illegible] river, the derrick and engine were taken arou[illegible] opposite side of the river with the bent remain[illegible] center of the river, and the balance of the p[illegible] built. Yours truly, Parker [illegible]

Waterford, N. Y., June 14, 1902.




A CABLEWAY FOR CONVEYING MATERIALS IN BUILDING CONCRETE PIERS, AT NORTHUMBERLAND, N. Y.

### Notes and Queries.

The lecture on "Bridge and Concrete-Steel Const[illegible] before the civil engineering students of Cornell Un[illegible] by Mr. Edwin Thacher, which was noted in the N[illegible] lications column of our issue of June 19, we are [illegible] can no longer be obtained separately. Those de[illegible] secure it can do so by purchasing the Transactions [illegible] Association of Civil Engineers of Cornell Universi[illegible] reviewed in our last week's issue.

In the article describing the 50-ton steel coal [illegible] the West Virginia Central & Pittsburg Ry., in [illegible] issue, its designer, Mr. Cornelius Vanderbilt, was [illegible] to as being engaged in the Motive Power Departme[illegible] the New York Central R. R. We believe it is true [illegible] Mr. Vanderbilt gained a practical knowledge of railway rolling stock through a connection with the office of Superintendent of Motive Power of the New York Central lines, but this connection ceased some time ago. The placing of the Jr. after Mr. Vanderbilt's name was also an inadvertence, since the two distinguished predecessors in the family having the same Christian name are no longer living.

A RURAL ELECTRIC DISTRIBUTION SYSTEM has been established in the province of Saxony, Germany. The central station is at Crottorf, where a maximum of 500 HP. is available from a fall in the River Bode. Three turbines of the Francis type utilize this power, with a normal capacity of 350 HP. The turbines are bevel geared to a single shaft, on which the generator is mounted. A 250-HP. horizontal compound steam engine is arranged to connect by friction clutch with this same shaft, so that either turbines or engine, or both, can drive the generator. Another engine of 500 HP. is connected to a similar generator (three-phase, 7,000-volt, 500-K.W. capacity, 125 r. p. m., 14-K.W. exciters mounted on same shaft). The current is distributed over the region within ten miles from the station, 27 different villages being supplied at present. Generally light and power are supplied directly from a single transformer, but in the larger villages, where a considerable power demand, particularly for agricultural uses, threshing, etc., is expected, motor-generator sets feeding storage batteries were installed. The whole system was constructed by the Helios Electric Co., of Cologne.

## ANNUAL CONVENTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The last of the four great national engineering societies to hold its summer meeting, the American Institute of Electrical Engineers, gathered its members on the four days from the 17th to the 21st of June for a renewal of professional brotherhood.

A novel meeting place had been chosen—Great Barrington, Mass., in the heart of the famous Berkshire Hills country. The convention was remarkable in another respect; the social side of the gathering had been enlarged upon to such a degree that it quite overshadowed the technical or professional side. And this fact is the more noteworthy because while the majority of those present were earnest professional men, with little taste for ordinary entertainments, they were entertained so well and skilfully that all of them passed the days of the convention in full enjoyment, without even being aware, seemingly, of the fact that their professional transactions were being crowded into the background.

The country around Great Barrington is beautiful. The weather was (at least more than half the time), almost ideal early summer weather. Lastly, the people of Great Barrington, the people of Pittsfield, and everyone else, it seemed, had laid themselves out to give the visitors a royal time. As a natural consequence, the visitors did have a royal time, and they felt throughout their enjoyments that they were at Great Barrington for a great week of vacation pleasure.

professional sessions suffered a little from this, as be expected. In the first place, on account of the and large scale of the entertainment, the meetings be crowded into the mornings, and to accommo- with this arrangement the many papers presented, necessary to extend the convention over four days. then each session had crowded into it so much of and interesting matter that it was drawn out for an thly length of time—the Thursday session, for in- lasted from nine in the morning to nearly two in fternoon. The endurance of the members was with- doubt taxed by such long sessions and such a long vention. Still, some most interesting discussion took , and if some of the papers received less attention their due, others received rather more, or at least given a generous measure.

The doings of this, the most successful convention ever by the Institute, may be chronicled as follows:

On Tuesday, June 17, a special train leaving New York 2 p. m. took a contingent of nearly 100 members and ts to Great Barrington, where the headquarters of the stitute were set up at the Berkshire Inn, a large and summer hotel. Here a reception was given the In- ute on Tuesday evening by the citizens of Great Bar- gton. Mr. Wm. Stanley, chairman of the local com- ittee, voiced a hearty welcome, which was responded to behalf of the Institute by Mr. T. C. Martin. Dancing followed.

* * * *

On Wednesday afternoon, a considerable number of the members visited the works of the Stanley Instrument Co., at Great Barrington, where Mr. Wm. Stanley guided them around the different departments and explained various features of the work in a most fascinating manner. A large number of girls are employed in the plant, in connection withh the delicate work on the parts of electric meters, and it was noted with surprise by all the visitors what a high class of female help was employed; the girls averaged more than ordinary good looks, and had a general air of intelligence. Later in the afternoon, a lawn party was given the Institute at "Brookside," the beautiful home of Mr. Wm. Stanley, by the members of the Ladies' Thursday Morning Club of Great Barrington.

On Wednesday evening a lantern exhibition was given in the Town Hall. Mr. T. C. Martin and Mr. L. Stieringer showed a series of slides illustrating electrical illumination at the expositions at Chicago, Atlanta, Omaha, Buffalo and Paris. The beauty of the effects reached by skilful use of electric lamps was strikingly shown by this collection of views. Mr. F. A. C. Perrine then presented a number of views, illustrating the subject "Engineering Methods on the Pacific Coast," which he accompanied with most interesting descriptive comment. A set of views on "Novel Applications of the Electric Motor" was presented for Mr. R. T. E. Lozier by Mr. W. B. Spellmire. Finally, Mr. Wm. J. Jenks showed and explained a very extended series of slides illustrating "Electricity from Nature's Laboratory," which was most wonderful. The talk constituted a complete treatise on lightning, and, unlike many treatises, it held all spellbound until its close.

On Thursday afternoon an organ recital was given at the home of Mr. E. F. Searles, at Great Barrington, by Mr. Harry Rowe Shelly, of New York city. The visitors were received at the Searles home and the whole house, with its rich collections of art treasures, was thrown open for their inspection. On Thursday evening the crowning social event of the convention came off, in the form of a grand Assembly in the Town Hall. As a result the session of the next morning was rather late in beginning.

A visit to Pittsfield had been arranged for Friday afternoon by courtesy of the Stanley Electric Mfg. Co. and the city of Pittsfield. A special train took the Institute to Pittsfield, where the ladies were entertained by carriage and trolley rides, while the others made a tour through the extensive works of the Stanley Electric Mfg. Co., ably piloted by its president, Mr. F. A. C. Perrine. After this a reception was given the Institute by Mr. and Mrs. Perrine at their home. In the evening the Institute was entertained at the Maplewood Hotel by the city of Pittsfield. An informal dance in the ballroom of the hotel closed the day's entertainment, the party returning to Great Barrington late in the evening.

A heavy downpour of rain spoiled whatever unofficial arrangements had been made for Saturday afternoon, among them a visit to Lenox, which had been planned by a large number of the members.

By the end of the convention, fully 250 had registered with Secretary Pope as members and guests. These included all the most notable of the present generation of electrical engineers and many others, so that there was ample material for most interesting technical meetings.

The professional proceedings of the convention are given below, with abstracts of the papers presented, and the discussion thereon. The following items may better be noted separately: The installation of president-elect Chas. F. Scott had to be omitted, as Mr. Scott is at present in Europe. A letter of regret had been received from him by Secretary Pope and was read. Regrets were also received from Congressman Lawrence, Gov. Crane, of Massachusetts, and a number of others.

A telegram was received on Thursday from the Pacific Coast Transmission Association, then in session, in regard to the new underwriters' rule relating to high-tension circuits in cities. The association had just passed a resolution most severely condemning this rule, and it asked the Institute to take up the matter also and express an opinion on the subject.

A communication from the Albany (N. Y.) Society of Arts expressed the opinion of that society in favor of a memorial to Joseph Henry to be erected in the city of Albany, and it expressed its willingness to co-operate with the Institute in that direction.

Just before the close of the convention, on Saturday, the Institute ranged itself in state session and passed resolutions of thanks (drawn up by a special committee) to all its many hosts during this convention. In addition, a magnificent silver loving cup was presented to the Ladies' Thursday Morning Club of Great Barrington as an expression of the appreciation by the Institute of the special efforts put forth by that organization for its entertainment.

## PROFESSIONAL SESSIONS.

The professional sessions were opened on the morning of Wednesday, June 18. As is the custom in the meetings of the Institute, papers on the same or related subjects were as far as possible presented in direct sequence; when the series of related papers was completed, and not till then, the subject was opened for discussion, and remarks on any of the papers of the group were then in order. This arrangement saves much time, as well as much useless repetition of comment. On the other hand, in the present case, it lent itself readily to aggravating a difficulty produced by the arrangement of the program; at nearly every session the presentation of the papers, many of which were "abstracted" nearly in full by their authors, took up such a large part of the available time, as well as of the physical and mental strength of those present, that the discussion fell far below what it should have been, both in quality and quantity.

The discussions were also unfavorably affected by the fact that the papers had not been distributed among the members before the convention. Indeed, only a few of the papers were ready for distribution even on the first day of the meeting. This, taken in connection with the large number of the papers presented (22) and the high quality and importance of most of them, had a noticeable effect in further diminishing the value of the discussions.

The following is a brief abstract of the substance of papers and discussion. The general subject before the Wednesday session was Alternating-Current Working, with six papers.

### A METHOD OF COMPOUNDING ALTERNATING-CURRENT GENERATORS AND MOTORS, DIRECT-CURRENT GENERATORS, SYNCHRONOUS MOTOR-GENERATORS AND SYNCHRONOUS CONVERTERS.—By F. G. Baum.*

This is a novel method of regulating the potential generated by an alternator. In a direct-current dynamo, it is generally desired to keep the voltage constant as the load increases, but in the case of the alternator the voltage should regulate (not necessarily remain constant) according to the power factor of the load. The author's method accomplishes this result. The essential point in the method is the use of a "compensator." This is a small dynamo, whose fields are in series with the main alternator circuit; its armature consists of a single coil connected to two slip-rings, one of which is a full metallic circle, while the other has only two opposite metallic segments. The armature of the compensator rotates in synchronism with the moving element of the alternator. As the field current of the compensator is alternating, the current flowing in its armature coil will depend on the angular relation of the alternator current to the rotational position of the moving element. Since this latter has a fixed relation to the main generated E. M. F., the impulses of current set up in the compensator coil will depend upon the phase relation of current and E. M. F. in the main circuit. The arrangement is such that when the main current lags, the compensator impulses are unidirectional, say positive; when the main current leads its E. M. F., the impulses are in the opposite direction, or negative. When the current is in phase, the impulses are short alternations of current.

Now, this compensator current is sent through the fields of a small dynamo, which latter supplies additional series coils in the field of the main exciter of the alternator. The effect of the whole arrangement is to increase the alternator field excitation (and, consequently, the potential generated), when the main current lags behind its E. M. F., and to decrease the excitation when the current leads. In this manner the potential generated by the alternator is regulated with changing power factor so as to maintain a practically constant current.

It may be remarked that the object in using a secondary exciter is partly to keep the compensator down to extremely small dimensions and partly to render the whole system safer against accidental derangement. It is possible by the compensator arrangement to base the regulation on the potential at some other point in the circuit than the generator terminals, etc.

### A FORMULA FOR CALCULATING THE ELECTROMOTIVE FORCE AT ANY POINT OF A TRANSMISSION LINE FOR ALTERNATING CURRENT.—By Maurice Leblanc.†

This establishes a general formula as indicated in its title. It takes into account the time of transmission of the alternating waves, and the resulting establishment of stationary waves in the system. The formula derived is of great and impractical complexity.

### THE NEW GENERATING PLANTS OF THE NIAGARA FALLS POWER CO.—By H. W. Buck.‡

This paper describes the new power house on the American side of the falls, which will develop 55,000 HP. The new plant is now almost completed, and will be in operation in a few months. This paper, together with the discussion relating to it, will be reprinted in a near issue of Engineering News.

### NOTES ON THE THEORY OF THE SYNCHRONOUS MOTOR, WITH SPECIAL REFERENCE TO THE PHENOMENON OF SURGING.—By Chas. P. Steinmetz.*

This is an analytical investigation of certain points in the theory of the synchronous motor, as pointed out in the title of the paper. It is divided into four sections; the first discusses load and phase characteristics of synchronous motors and converters; the second discusses the effect of variations in velocity on the stability of the action of the machine, constant load being assumed; the third section considers a load varying with the speed; while the fourth considers an unbalancing factor, as a load varying in the opposite direction to the speed, or certain damping devices.

The whole treatment is mathematical, but in the logical and luminous style peculiar to its author; moreover, the basal considerations are briefly called to mind in the first section by the help of diagrams and formulæ.

The last-mentioned of the preceding papers were read in abstract by their authors; the paper of Mr. Baum was presented by Mr. F. A. C. Perrine, that of Mr. Leblanc by Mr. P. H. Thomas. Two papers belonging to the general subject were postponed until another session, as the authors had not yet arrived.

## DISCUSSION.

In opening the discussion, Dr. F. A. C. Perrine gave from a letter received from Mr. Baum, some data obtained in actual use with the "compensator" described in Mr. Baum's paper. The data included the operation of synchronous motors as well as generators. The results obtained seemed to have been entirely favorable.

President Steinmetz expressed much interest in Mr. Baum's paper, but thought some objections might be urged against his device. As the most important of these he would mention the lag in action due to the progress of the regulation through the compensator and the two exciters to the generator. Years ago he had tried a method quite similar to this one to control the field of the exciter, using a potential magnet as the regulating element; the results had been entirely unsatisfactory. The lag in the regulation would, he thought, be apt to produce surging or hunting or tend to produce it. Of course this disturbance might steady an otherwise unsteady machine by interference with the beat of the principal unsteadying force, such as electro-mechanical oscillation. He called attention further to the fact that the rectifier must operate synchronously with the main generator, which would generally mean that it must be geared to the generator shaft. While this was perfectly possible, it yet brought in the objectionable element of gearing, which in general electrical engineers desired to eliminate as far as possible.

Dr. A. E. Kennelly, referring to the paper of Mr. Leblanc, expressed the hope that the final equation obtained might be considerably simplified, so that it might be made practically useful. He thought that this might be found to be possible, and suspected that the introduction of complex quantities or the use of hyperbolic functions, or both, might lead to this simplification.

Mr. H. T. Eddy called attention to the great help toward comprehension of alternating-current phenomena, even such as are treated in the paper of Mr. Leblanc, that could be obtained from a consideration of the complete hydraulic analogue, with its parallels for resistance, capacity and self-induction.

Prof. C. A. Adams protested against going back to the hydraulic case for an aid to the understanding. He was of the opinion, on the contrary, that the real mental difficulties were the same in both cases (a thorough acquaintance with fundamental concepts and phenomena presumed in either case), and that it was fully as easy (and for the electrical man, even easier) to obtain a comprehension of the electrical case as of the hydraulic. Referring to the paper of President Steinmetz, Prof. Adams then outlined a method of studying the synchronous motor which was originally due to Blondel and published by him in 1895, but which Prof. Adams thought was not generally known. The method is not strictly accurate, but is a clear and convenient graphical representation of the phenomena to be studied.

Mr. Thomas seconded the opinion advanced by Prof. Adams regarding the relative difficulty of comprehending electrical phenomena and their mechanical analogues, and he carried this idea a step farther. He would study the general case, the principle of action underlying both the cases in question alike, and after comprehending this most general idea, would then turn to the special case.

This view was characterized by President Steinmetz as being very seductive in theory, but impossible of realization. He had himself once tried to work out in this manner a general theory based on an incompressible fluid, and had found the task an impossible one. He had found himself forced at every point to turn away from his ideal case and consider the actual conditions in the problem which his theory was intended to cover. He called to mind that whenever a general theory was published, on whatever subject it be, it would be found to be subsequent to actually reaching in practical realization the results of the theory, and that though the theory as given might be developed throughout in a strictly general and theoretical manner, yet it was never obtained or arrived at in such a way, but was always laboriously worked out

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and pieced together from observed phenomena. However, even though the main results be already known and the subject of a theory fully understood before the theory be worked out, yet the latter will be of value in giving a broader and more open view of the subject.

Concerning his own paper, President Steinmetz wished it to be understood that it was put forward not as a complete theory of hunting in synchronous machines, but as a foundation upon which such a theory might be built up.

(The portions of the discussion that referred to the paper of Mr. Buck describing the new generating plant at Niagara Falls, are omitted here and will be given in connection with the paper itself in a later issue, as already noted.)

The session of Thursday, June 19, was an important one, and in spite of the fact that the meeting was for this one time called at the scheduled time of 9 a. m., it was close on 2 p. m. when the Institute adjourned for the day. The subject was "Electric Railway Work," and was covered by four papers. In addition one of the papers on the program for the previous day was read.

A STUDY OF THE HEATING OF RAILWAY MOTORS.—By A. H. Armstrong.*

This paper considers the losses in railway type motors as varying with total train-weight per motor, schedule speed, and frequency of stops. As the principal factor in the matter of capacity of electric motors is heating, especially with the enclosed or railway type, it will be seen that the investigation touches directly the problem of properly proportioning the electric equipment of a car to the service required. The train and car-resistance values used in the calculations are those obtained by the General Electric Co. in tests on the Buffalo & Lockport Ry.† In the present paper the maximum temperature rise was determined (for the General Electric type "H" motor), by actual test runs for observed losses. The distribution of these losses at any given speed being approximately known, the heating of the motor could then be calculated for any schedule speed and any length of run. From these results curves of equal heating are deduced, giving the relation between number of stops per mile, train-weight per motor, schedule and maximum speed. Some conclusions are drawn as to proper gear-ratio, the running of single cars or trains for high speeds, etc. The whole study is based on a single style and size of motor, but the conclusions appear to be applicable, at least qualitatively, to any commercial railway motor.

COMPARATIVE ACCELERATION TESTS WITH STEAM LOCOMOTIVE AND ELECTRIC MOTOR CARS.—By B. J. Arnold‡ and W. B. Potter.§

This paper reports the results of some of the preliminary work carried on in connection with the study of electric traction on the Mott Haven division of the New York Central & Hudson River R. R., reported by Mr. Arnold in a paper noted below. It was desired to find the drawbar pull, acceleration, and similar data for a representative steam locomotive and electric motor cars. The (two) motor cars were each 54 ft. over all, weighing 35 tons, fitted with four G. E. 55 motors and type M control. The locomotive, No. 1407, was a new one, built especially for suburban service to designs of Mr. A. M. Waitt, Superintendent of Motive Power of the N. Y. C. & H. R. R. R., by the Schenectady Locomotive Works. It is of the Forney type, with 128,000 lbs. on drivers and 214,000 lbs. total weight. It has 2,465 sq. ft. of heating surface, 63 sq. ft. of grate surface, 63-in. drivers, and 20 × 24-in. cylinders. The electric runs were made on an experimental track of the General Electric Co. at Schenectady; the steam runs were made on the New York Central main line track west of Schenectady.

In acceleration the electric motor cars, for the same train behind locomotive, had considerably the best of the steam locomotive for all train lengths from one to six trailers. The runs were about a mile in length, and in every run the electric locomotives made the full run in shorter time than the steam locomotive. Calculations of energy input also showed the electric motor cars to have the advantage per ton mile, and even more so per passenger mile. On the basis of logs of daily service of steam locomotives on suburban runs, counting in all the coal burned while lying idle, etc., their average coal consumption figured up to about 15.6 lbs. per HP. hour, while the power house coal consumption for the electric service would be only about 6.6 lbs. The actual cost of operation would on this basis be about the same for both. This idea is developed completely in the paper of Mr. Arnold, noted below.

AN EXPERIMENT WITH SINGLE-PHASE ALTERNATORS ON POLYPHASE CIRCUITS.—By C. O. Mailloux.‖

A water power three-phase electric plant, 24 miles from Phoenix, Ariz., supplies electrical energy at 22,500 volts to the latter city. A second such plant nine miles from Phoenix is to be built in the near future. The transformer substation is located at the old steam electric generating station at Phoenix. In the substation the line-current is stepped down in two ways, (1) to three-phase at 350 volts for supplying rotary converters for power service, and (2) to two-phase, at 2,250 volts (by means of Scott transformers) for lighting. The frequency is 60 cycles. The steam plant is to be altogether discarded when the second water power station is built. However, until then it may be desirable to use this plant to help out the first water power station. The experiment noted in the present paper was made to determine how far this was possible; the alternators in the steam plant were single phase, and it was not known how they would operate under different conditions if connected with the two-phase lighting circuit at the substation. It was found, on actual trial, that when the single-phase generators were connected to the two phases of the lighting circuit, and thrown in properly synchronized, while the transmission line was properly connected, there was no difficulty in keeping them in step or properly distributing the load. The following experiment was then tried: When the single-phasers were in this connection, and the rotary converter on the power circuit was in operation, the transmission line was disconnected from the system, leaving the single-phase generators feeding the rotary converter through the Scott two-phase—three-phase transformers. It was found on many repetitions of the experiment that the generators behaved entirely satisfactorily under these conditions, keeping in proper phase and balance without surging. When the rotary converter was disconnected, however, the two alternators dropped out of step at once. With the rotary converter acting as synchronizer, therefore, the operation under the conditions outlined was fully successful.

METHOD OF ASCERTAINING BY MEANS OF A DYNAMOMETER CAR THE POWER REQUIRED TO OPERATE THE TRAINS OF THE NEW YORK CENTRAL & HUDSON RIVER R. R. BETWEEN MOTT HAVEN JUNCTION AND GRAND CENTRAL STATION, AND THE RELATIVE COST OF OPERATION BY STEAM AND ELECTRICITY.—By Bion J. Arnold.*

This paper is compiled from a report made by the author some months ago to the New York Central & Hudson River R. R. on the feasibility of operating the division mentioned in the title by electricity. The report favors such a system and analyzes in detail different arrangements of the electric system, with the recommendation that a certain system as detailed be adopted. The paper is of great importance, and will be fully abstracted in a future issue of Engineering News.

NOTES ON THE PLOTTING OF SPEED-TIME CURVES.—By C. O. Mailloux.†

This paper enters at length into a mathematical discussion of the relations between train resistance, speed, acceleration, etc., developing formulas for the calculation of all problems arising in the dynamical study of electric railroading. The object of the work is to facilitate the use of speed-time curves for the precise analysis of such problems. A graphical method is developed to this end.

DISCUSSION.

President Steinmetz, in opening the discussion, referred to the experiment with single-phase alternators on polyphase circuits, and called attention to a general rule governing the combination of alternating-current machines, according to which rule the combination must be such that the different elements of the system are related in a way analogous to a stable framework in mechanics.

Mr. Murphy, referring also to Mr. Mailloux' experiment, said that the conditions at Ottawa were somewhat similar, there being two water power stations, one two-phase, the other single-phase, the two stations being operated in combination with entire success.

Mr. H. E. Heath pointed out that the single-phases in Mr. Mailloux' case could be thrown in by starting the rotary converter from the direct current side, as by means of a storage battery or other suitable source. Mr. Mailloux agreed with this, and stated that the intention was to operate in this way as soon as a storage battery should be available at the substation.

Mr. F. J. Sprague, discussing the railway papers of the session, asserted that the comparatively small economy of electric traction over steam traction as developed in Mr. Arnold's paper, should really be of only small importance in deciding the question. He would emphasize primarily the safety of electric operation, and then the improved service that could be offered and the increased traffic that would result from this. He was of the opinion that the electric locomotive was not the motive power of the future, but rather the system of separate units which could be combined in any manner and gave a perfect flexible system. In this connection he brought to mind the 700-HP. electric locomotives on the Central London Ry., which were now being displaced by multiple-unit trains.

Mr. F. S. Pearson looked for the development of electric traction not in heavy traffic, but in light and frequent suburban service on the one hand and high speed, long-distance service on the other.

The steam locomotive has just been called upon for 20-hour service between New York and Chicago; he looked forward to the day when electric traction should cut down this time to ten hours.

Mr. Langdon Smith, taking up the statements of the last speaker, insisted that the track was the weak point in the matter of high speed traffic. He claimed that speeds of 100, 125 and more, miles per hour were absolutely impossible not only with present track but with any track laid on the ground and on which trains ran without secure mechanical connection. The real problem of high-speed running is not electrical but mechanical; a new type of track structure, and a method of operating a train in firm connection therewith, would have to be devised before anything like 125 or 150 miles per hour would be possible. This same point was also referred to by Mr. A. H. Armstrong, who said that the problem of high-speed traction lay in building cars of mechanical construction strong enough, wheels strong enough, and a roadbed resisting and enduring enough for such traffic.

Mr. H. W. Leonard spoke of a locomotive now being built at the Oerlikon Machine Works (Switzerland), according to a system brought out by himself a number of years ago. This locomotive is to be of 700 HP. for 10,000 lbs. drawbar pull; it will be supplied by single-phase current at high tension, generated in stations 50 to 75 miles apart. The car will be operated on the system known as the Ward-Leonard system. It is expected that results from the operation of this locomotive will become available in a few months.

Mr. W. B. Potter, in connection with the matter of roadbed, deplored the fact that a gage of 4 ft. 8½ ins. had become universal. He should like to see a 6-ft. gage in use; in that case it would be possible to construct larger and stronger trucks, wheels and axles, with greater wheel-bases than now customary, and the wide gage would also enable a roadbed to be constructed that would carry the future high-speed traffic with security.

Mr. B. J. Arnold agreed with Mr. Potter, regretting that a 6-ft. gage was not available for electric running. Mr. Arnold then read a communication to the Institute which he had prepared and which he wished to present in connection with the subject of "Electric Railway Work."

The communication described a new system of alternating-current electric traction devised by Mr. [illegible]. Besides being the only word spoken at the convention in favor of alternating-current traction, it was also interesting because of the novelty of the system, and because a line 20 miles long is now being constructed on the new system. This communication will be separately reproduced in full in our next issue.

The convention then adjourned until the next day, Friday.

(Concluded next week.)

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†See Engineering News, June 19, 1902.

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"COMMERCIAL ALASKA IN 1902" is the title of a publication of the Treasury Bureau of Statistics. This sets forth the commercial conditions and trade opportunities and prospects, the industries, etc., of Alaska. It notes that Alaska, for which the United States paid $7,200,000 in 1867, has to date supplied furs, fish and gold to the value of $150,000,000; that about $25,000,000 has been invested in enterprises there by Americans; that the annual shipment of goods to Alaska now amount to $12,000,000 and aggregate at least $100,000,000 since 1867. The population has grown from an estimate of 50,000 in 1867 to about 75,000. In the aggregate production since 1867 the value of seal and other furs is put at $50,000,000, and the total value of fish taken is placed at the same amount.

AN AUTOMATIC CABLE RELAY has been perfected and is being used on several long submarine cable lines, according to an article in the London "Electrician." One of the first lines to be fitted with the relay was that from Porthcurnow, England, to Alexandria, Egypt, relayed at Gibraltar. The two principal difficulties which had to be met in the design of the apparatus were the electrical sticking of the contact and the mechanical sliding friction between the moving and the fixed contacts (butting contacts being impracticable for electrical reasons). The first named trouble was gotten rid of by shunting suitable condensers around the contact. The second was solved by making the contacts to form adjacent lengths of the surface of a rotating cylinder, with the moving contact tongue, actuated by the first, or sending, cable, playing longitudinally on this cylinder. The rapid rotation of the cylinder very greatly decreases the moving friction between the tongue and the contacts, and may be said to eliminate entirely statical friction. This relay, when used on high-speed transmission over long cables, requires an auxiliary apparatus, called "interpolator," to restore certain of the variations in the sending impulse which have become smoothed out in passage over the cable.

## ANNUAL CONVENTION OF THE MASTER CAR BUILDERS' ASSOCIATION.

The thirty-sixth annual convention of the Master Car Builders' Association was held at Saratoga, N. Y., June 18, 19 and 20, 1902. Owing to the burning of the Saratoga Theatre on June 9, the meetings were held in the ballroom of the Grand Union Hotel, which, because of the noisy surroundings and the poor acoustic properties of the room itself, proved a very unsatisfactory substitute. Despite the drawback of not being able to hear clearly, the discussions were active and well sustained, and the technical work of the convention was quite on a par with the average of past meetings. As is usual, a large part of the opening session was taken up by the consideration of special and routine business, and an equally large part of the middle session was consumed in reading and revising the Rules of Interchange; this made the period for the reading and discussion of committee reports somewhat more restricted than was desirable.

OPENING SESSION.

The first session of the convention was, in accordance with the long-established custom of the association, opened with prayer. A brief address of welcome was then made by Mr. A. P. Knapp, President of the village of Saratoga, and followed by a suitable acknowledgment by Mr. A. M. Waitt, of the association. President J. J. Hennessey (C., M. & St. P.) then formally opened the work of the convention by a short address. After reviewing the objects of the convention and its work in the past in the line of formulating rules of interchange and devising standards for car construction, Mr. Hennessey referred to the work before the present convention, and to that which from present indications the future was likely to present. Two items of future work, namely, the preparation of designs for standard metal cars and standard metal underframes, and the

consideration of plans for cars of larger capacity than 100,000 lbs., were enumerated as deserving immediate attention from the association.

The report of the Secretary, Mr. J. W. Taylor, showed a total membership of 491, made up of 275 active members, 150 representative members, 8 associate members, and 18 life members. The number of cars now represented in the association is 1,630,016. The receipts during the year were $16,[illegible] which had met all expenses and left a substantial balance to be added to the balance accumulated in past years. The Treasurer, Mr. John Kirby (L. S. & M. S.) announced that with all bills paid the association now had in the bank a balance of $9,165. Owing to the excellent financial condition of the association it was voted upon the recommendation of the Executive Committee that the dues for the ensuing year be made $1 less than for the year past, or $3.

Under the head of new business, it was voted to amend the constitution by adding as Section 5 the following:

"Members of this association, either active or representative, who have been in good standing 25 years, may become candidates for life membership on the recommendation of the Executive Committee. The names of such members shall be referred to the association convention for election by ballot at any regular meeting of the association, and five dissenting votes shall reject.

Notice of a proposed amendment of the constitution to be voted upon next year was presented by Mr. John S. Lentz (L. V.) and was ordered ahead for action by vote of the convention. This proposed amendment had for its purpose the admission of mechanical engineers who were not master car builders, to the association as active members instead of limiting them to associate membership, as is now the case.

STANDARDS AND RECOMMENDED PRACTICE.—The report of this committee, presented by Mr. A. M. Waitt (N. Y. C. & H. R.), proposed a number of changes in the standards and the recommended practice of the association. Most of these changes consisted of transferring items of recommended practice to the list of standards and of minor changes in details. It was voted that all the changes recommended be submitted to letter ballot for approval.

TRIPLE VALVE TESTS.—The chairman of this committee, Mr. G. W. Rhodes (B. & M. R.), reported that as no triple valves had been submitted for testing during the year, no tests had been made, and no report of tests was possible.

LABORATORY TESTS OF BRAKESHOES.—The report presented by Mr. J. E. Simons (Pitts. Coal Co.), the chairman of this committee, was, in abstract, as follows:

The committee report presented at the association meeting of 1901 was rather exhaustive and covered the question of tests so thoroughly that there was nothing for this committee to do except to ascertain as far as possible what efforts were being made by the members of the association to adopt the co-efficient of friction recommended by the former committee and later adopted as standard by the association. Your committee therefore made inquiry by circular whether any of the members desired it to test the shoes being used, and the replies received from that inquiry indicate that a very large percentage of the members are using shoes that were tested by our predecessors, and as the results obtained are satisfactory in nearly all instances, the necessity of another test so soon after the adoption of the co-efficient of friction as standard, was evidently considered as premature, and consequently no tests were made. In connection with the circular of inquiry, the committee deemed it advisable to ascertain if possible the result of the continuous application of brakes on grade. From the replies received, the indications are that the results in some cases are disastrous to the wheels, causing overheating and checking of the tread, eventually forming comby spots and circumferential cracks in or adjacent to the throat, and surface cracks across the tread normal to the flange. It has not been definitely determined, however, that the long-continued application of the brake is the real cause of this, but the fact that these conditions exist on roads having long, steep grades, more noticeably than on roads having light grades, would make it appear that there is room for further investigation along the lines of the effect of temperature, and that some effort should be made to obtain more knowledge in regard to the friction of brakeshoes and its effect upon cast-iron wheels under heavily loaded cars by continuous application of the brakes. Your committee is of the opinion that steps should be taken wherever possible by members of the association, to check the results obtained by the Committee on Laboratory Tests of Brakeshoes, making practical tests in actual service of shoes having the frictional qualities of the recommended standard.

In concluding his report, Mr. Simons made a motion that the Executive Committee be instructed to consider the practicability of having conducted a series of road tests of brakeshoes. This motion was passed by vote of the convention. Previous to this action, however, it was pointed out by Mr. R. P. C. Sanderson (Seaboard Air Line) that road tests had been attempted by the original committee and that no useful results had been obtained owing to the fact that the roads making the tests did not succeed in keeping track of the test shoes, or of the mileage they ran, owing to the loss of the shoes in wrecks and repairs, and to other causes. The action on this report concluded the work for the opening session.

## SECOND SESSION.

TESTS OF M. C. B. COUPLERS.—The report of this committee opened with the statement that its work had been seriously hindered by its inability to obtain the use of the drop-testing machine at Altoona, and concluded with a recommendation that steps be taken at once to use the drop-testing machine at Purdue University which had already been authorized by the association. In addition to this statement and recommendation, the report advised a change in the standard coupler contour gage, which would make the coupler stronger, and referred to the abolition of the link-pin holes and link slots in knuckles, and to some few tests made on coupler heads and butts. Its remarks upon these last subjects were in abstract as follows:

Your committee is sure, and the opinion seems to be very general, that the abandonment of the link-pin holes and link slots would be the greatest improvement to the automatic coupler that could be made at the present time, but there still seems to be some objection to making this change until some supplementary device is found which will be entirely satisfactory and adequate for handling cars around short curves in mill yards and at warehouses, as well as on and off floats where the water level varies greatly. Your committee has experimented with several devices for handling cars around short curves, which are partially successful, but which cannot be said to meet all the requirements of the service, and on this account we feel compelled to give up recommending the change at this time. From an inspection of 400 knuckles of various different kinds, taken at random from a scrap pile, it was found that 37⅛% of the failures were due to the link-pin holes and 21% to the link slot, while 12% and 29½% of the failures were due to the tail and to the knuckle-pin hole, respectively, which plainly shows how great a saving would be effected by the use of the solid knuckle. It also shows that there is a great weakness at the knuckle-pin hole, where the trouble will be much harder to remedy.

Your committee has made some few tests of the head presented last year for experiment, which suggest first of all, that it is impracticable to use a 1⅝-in. pin in a head 8 ins. between lugs. From these tests a type of coupler was used in which the end of the tail of the knuckle fitting squarely against the head showed, after the specification test, that the pin had been relieved of considerable punishment. Even in this type of coupler the 1⅝-in. pins in these three tests made were bent ¼-in., ¼-in. and 3-16-in., while in two of them the knuckle would not open after three blows of 5 ft. and two blows at 10 ft. This shows plainly that the longer pins will bend in the holes unless they have large enough section to give them the required stiffness. A striking test of a coupler of the same type and same distance between lugs, but with 3-in. lugs instead of 2½-in. and a 1¾-in. knuckle pin showed a perfectly straight pin after the test, and the knuckle and locking devices remained operative until the seventh extra blow at 10 ft., which broke the knuckle through the knuckle-pin hole, and the pin then only showed a scant 1-16-in. bend. From this it seems that a knuckle with an 8-in. hub can hardly be recommended with the present contour, from the fact that the 1⅝-in. pin bends too much, while the 1¾-in. pin increases the present weakness through the knuckle-pin hole and at the lugs of the bar. The 13-in. face for the knuckle, as suggested last year, does not seem advisable, since one 10 ins. deep proves to be stronger through this part than through the hub.

In view of the fact that we hope very soon to be able to abandon the link-pin holes and link slots, which will make this the strongest part of the knuckle, and transfer almost the entire breakage to the knuckle-pin hole, it seems that this extra depth is not the direction toward which we should be working. We would rather look for some other way to get a bar with stronger lugs as well as a knuckle much heavier and stronger through the knuckle-pin hole, where even now with the 1⅝-in. pin, the percentage of breakage is very great. To do this would mean a change in contour, which might be made so gradually that little difficulty would be experienced. Your committee realizes that this is a serious proposition, which will have to be faced sooner or later, in order to get the additional strength in the lugs of the bar and in the pin, as well as in the knuckle, at all of which places the failures are becoming very serious. Your committee thinks that increased strength of lugs will be better obtained by an increase in section rather than in depth, which may also be said of the knuckle at the pin hole.

Another feature of the experimental head presented last year is the increase of 1 in. in the distance from back of horn to inside face of knuckle. Some types of couplers may need this for strength or for providing more room inside for knuckle and locking devices, while other types do not need it. As your committee does not know of any reason why this distance should be maintained exactly the same, knowing well that it cannot be less than it is now or much greater on account of the extra weight of metal unnecessarily involved, it is recommended that a little latitude be allowed to the discretion of the makers and that this measurement be not specified.

To sum up, your committee believes that a head 11 ins. or 12 ins. deep, with a 9-in. or 10-in. face for a solid knuckle, the contour of which should be changed to admit the use of a 1¾-in. pin would meet all the requirements of the heaviest service, but thinks that another year's experience with these heavier types is necessary before any definite recommendations can be given.

Five comparative pulling tests have been made with the increased butt riveted up in different combinations. From these results it appears that the strength of the lips with two rivets is very much in excess of any direct drawbar pull ever found in service. Whether a third rivet is needed to give extra stiffness or to stand excessive shocks, only experiment can determine, which also will be necessary to prove the advantage of the short rivet method over the old one. From the pulling tests very little information on this subject could be gained, except that after test 2 the rivets were all much looser than after test 3, so your committee does not recommend a change until more information can be obtained from service conditions, which could be best had by using the two methods at the different ends of the same cars. A little more experience with these butts will also give more information concerning the comparative facility with which the work can be done. In the old method your committee suggests that the rivets be inserted from the opposite sides of the yoke, which results in having one hole well filled on each side. It is also suggested that the fillets at the lips of the yoke always be kept smaller than the radius of the corners of the butts.

The discussion on this report was opened by Mr. R. P. C. Sanderson (Seaboard Air Line), who expressed his full agreement with the assertion that strength should be added to the coupler by changing the contour lines rather than by increasing the depth. This change, however, should not be left to the manufacturer, but should be authorized from year to year, as directed by the association's Committee on Standards. Mr. F. H. Stark (B. & O.) stated that some two years ago his road commenced to use couplers with solid knuckles, and were satisfied that the practice had reduced the knuckle breakages very greatly. There were some difficulties in passing curves of mile tracks, but these were avoided when the cars were equipped with safety chains, and in any case a little trouble here was outweighed by the advantages gained in other ways.

Mr. Wm. C. Appleyard (N. Y., N. H. & H.) thought it was time to abandon the pin hole and link slot. His road, owing to its frontage on the Harlem River, where the tides gave a constantly fluctuating grade in handling cars onto and off car floats, presented as hard conditions perhaps as any road in the country, and yet he got along without the pin hole and link slot. Mr. A. M. Waitt (N. Y. C. & H. R.) agreed with Mr. Appleyard that it was time to abandon the pin hole and link slot, and made a motion that the association recommend to its members in purchasing knuckles that they specify the omission of the pin hole and slot, and that the standing committee on coupler tests be instructed to make inquiry and report to the convention next year the results obtained by that change. This motion was carried by vote of the convention. Mr. Waitt then made a motion that the drop testing machine for couplers be installed at Purdue University in accordance with the recommendation of the report. This motion was also passed.

METHODS OF CLEANING AIR BRAKES.—This report, presented by Mr. C. H. Quereau (N. Y. C. & H. R.), consisted of three sections, the first relating to the methods of cleaning air brakes, the second relating to methods for testing triple valves and the third relating to prices for labor on air brakes. We print extracts from the first and second parts, as follows:

The brake cylinder and its parts need not be removed from the car for cleaning. First, secure the piston rod firmly to the cylinder head, then, after removing the cylinder head, piston rod, piston head and release spring, scrape off all deposits of gum and dirt with a narrow putty knife and place the removed parts in kerosene or other light oil, leaving them there until the inside of the cylinder is thoroughly cleaned. Particular attention should be paid to cleaning the leakage groove and the brake cylinder tube. Then clean the parts which have been soaking, removing the packing leather and expanding ring for proper inspection and cleaning. When the expanding ring is free its ends should be from 1¼ to 1½ ins. apart. In all cases the follower nuts should be drawn up snugly before replacing the piston head and the inside of the cylinder and the packing leather evenly coated with a suitable grease or vaseline.

The triple valve should be removed from the car for cleaning in the shop, to be replaced by a triple in good condition. It should be dismantled and all the parts, except those with rubber seats, immersed in kerosene to soften the accumulated oil and gum. Particular pains should be taken in cleaning the feed groove not to enlarge it. Rags, or better still, chamois skins should be used rather than waste, as the latter invariably leaves lint on the parts on which it is used.

Should the triple piston packing ring need to be renewed or the bushing require truing, we strongly recommend that this work be done by the manufacturers. We are thoroughly convinced that the average workman cannot, at least does not, do work of this kind satisfactorily, and that by far the largest proportion of the attempts to economize in this way result in insufficient air brakes and slid flat wheels.

TEST NO. 1.—The tightness of the slide valve, the emergency check valves and all joints should be determined by painting with soap suds.

TEST NO. 2.—Maintaining a pressure of 90 lbs. in the train pipe, the auxiliary pressure should reach 70 lbs. in not less than 45 secs. or more than 60 secs., as provided in Test No. 9 of the M. C. B. air brake tests.

TEST NO. 3.—To test repaired triples for release, charge the auxiliary to 70 lbs. pressure and make a full service reduction of 20 lbs., or until the auxiliary and cylinder pressure are equal. Place the special cut-out cock in such position that pressure must pass through the 3-64-in. port, and turn main reservoir pressure of 90 lbs. into the train pipe. If the triple does not release under these conditions, it should be condemned.

TEST NO. 4.—The triple piston packing ring should be tested for leakage by blocking the piston in the graduating position, maintaining the train pipe pressure at 70 lbs. Under these conditions the pressure in the auxiliary reservoir should not increase faster than 15 lbs. per minute.

The discussion on this report was opened by Mr. Willis, of the special committee of the Air Brake Association, who criticised the methods recommended in the report in several particulars.

In replying to this discussion, Mr. Quereau stated that the majority of the suggestions made had the approval of the committee, and but for lack of time for a proper conference, they would have been adopted in the report.

REVISION OF RULES OF INTERCHANGE.—The report of the Arbitration Committee and the revision of the rules of interchange was taken up immediately following the discussion on the preceding report and consumed the greater part of the rest of the session. The larger portion of the discussion related to the one or two changes in the rules which seemed necessary to make them conform to the new per diem charge for cars adopted by the American Railway Association, and its result was that the various recommendations and resolutions were finally referred to the Arbitration Committee to be threshed over and embodied in a final recommendation from that committee to be presented at the closing session.

STANDARD AXLES AND SPECIFICATIONS.—This report was presented by Mr. E. D. Nelson, and stated in substance that the committee did not feel that the M. C. B. specifications of 1896 had been in use long enough to determine whether axles made according to their requirements had or had not proven successful, and therefore that it was unwarranted in suggesting any changes as

the result of actual experience. The report also stated that:

As to the possibility of making limiting weights and dimensions for axles, your committee does not feel that this is necessary. The dimensions adopted for different portions of the axle should be followed as closely as it is possible to do in practice, and by introducing the question of the limit of weight it simply becomes a disturbing factor.

Mr. Nelson added, in presenting the report, that since it was written the committee had come into possession of information which led it to recommend the following changes in the specifications:

Deflection, 4½ × 8-in. journal; desired deflection, 7 ins.; limit of deflection, 7½ ins., 5 × 9-in. journal; desired deflection, 5¾ ins.; limit of deflection, 6¼ ins., 5½ × 10-in. journal; desired deflection, 4 ins.; limit of deflection, 4½ ins.

These recommendations were ordered to be submitted to letter ballot by vote of the convention.

Mr. A. M. Waitt (N. Y. C. & H. R.) questioned the decision of the report that the specifying of limiting weights was unnecessary, and stated that by specifying limiting weights he had secured decidedly better axles.

RULES FOR THE EXAMINATION OF CAR INSPECTORS.—This report mapped out the course of work most desirable for the schooling of car inspectors, and also suggested a list of questions indicating the character of the examination to which candidates for this position should be submitted. It also gave a mode of procedure for testing sharpness of vision, field of vision, hearing and perfection of color sense.

The discussion was opened by Mr. F. H. Stark (B. & O.), who stated that it was an unfortunate fact that the standard of car inspectors was being lowered instead of elevated. This he considered to be due to the low compensation established by railways for that class of work.

## CLOSING SESSION.

SPLICING PASSENGER CAR SILLS.—This report, presented by Mr. J. S. Lenz (Lehigh Valley), gave in detail the answers received to a list of nine questions asked by the committee. In conclusion it said:

Your committee, having received drawings of various forms of splices and considering the subject of sufficient interest and value, determined to make a test of the various types most generally used and that could be tested with the facilities at hand. All tests were made in wheel presses. The first series were made at Sayre, Pa., under the direction of Mr. J. Hawthorne, Master Mechanic, and the second set at Norwood Central, Massachusetts, by Mr. T. W. Adams. The result of the two

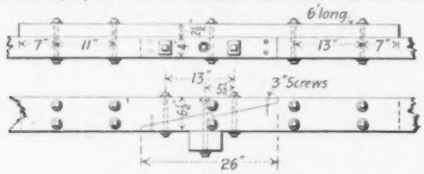



Fig.1. Pullman Splice for Intermediate Sills.

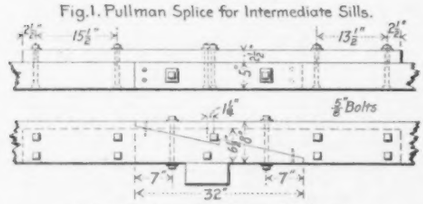



Fig.2. Pullman Splice for Side Sills.

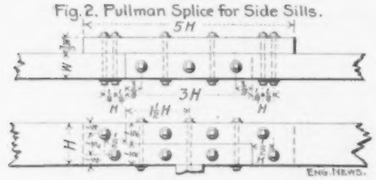



Fig.3. Splice Standing Highest Test.

**Figs. 1, 2 and 3. Splices for Passenger Car Sills Suggested as Recommended Practice by a Committee of the Master Car Builders' Association.**

series of tests show that the lock splice, as commonly used, is not as strong under compression, and it would appear not as strong under transverse loading as the step splice, and very little stronger than some of the other forms of splices. It would seem to the committee that if the splice is properly located over a needle beam, so as to eliminate vertical strains, the step splice is much superior. It is also apparent that this form, besides being stronger than the lock splice, can be applied at less cost, especially in the repairing of cars. Two forms of splices are shown, Figs. 1 and 2, known as the Pullman standard, a practice most generally followed for splicing intermediate and side sills, and Fig. 3, the step splice, which stood the most satisfactory tests, and which is recommended for all sills. Your committee is of the opinion that under these existing conditions both of these forms should be submitted to letter ballot for adoption as recommended practice, and in the event of neither receiving the required two-thirds vote on the first ballot the one receiving the largest number of votes be again submitted to ballot.

The discussion on this report was brief. Mr. W. E. Fowler, (Nev., Cal. & Ore.) stated that the Southern Pacific had recently tested by compression a standard splice, a reinforced splice, a step splice and a solid beam, and had found the standard splice and reinforced splice 40% weaker than the solid beam. The step splice, however, showed a result similar to that mentioned in the report. On motion of Mr. A. M. Waitt (N. Y. C. & H. R.) the splices suggested by the report were submitted to letter ballot.

The next report was that of the committee on Draft Gears; this report and also the following one on Side Bearings and Center Plates we postpone to a following issue.

CAST-IRON WHEELS.—This very brief report stated in substance that it was so short a time since cars of 100,000 lbs. capacity and over had come into service that no reliable conclusions could be drawn regarding the efficiency of cast-iron wheels for such heavy cars.

The discussion of this report was opened by Mr. Geo. L. Fowler, who stated that about a year ago he had investigated the subject of cast-iron wheels for 80,000-lb. cars. In consulting with motive power officials he had found a wide variation of opinion and experience. On some roads the failures had been numerous. On other roads there had been practically no unusual failures. A comparison of his notes showed that the roads recording an unusual number of failures were roads having heavy mountain grades and much short curvature, while those showing no unusual increase of failures were the level roads. Some cars which gave no trouble on level sections began to have wheel failures when transferred to mountain sections. The failures were circumferential cracks along the flange, which finally gave way. This failure had been overcome by thickening up the plate and carrying the bracket out so that instead of an undercut back underneath the flange there was a little swell. Wheels designed in this manner were showing fewer failures, but such failures as occurred were the result of cracks forming across the tread parallel to the axle, much the same as cracks produced by the thermal test. Furthermore some of these cracks seemed to originate in the interior of the metal and gradually work outward to the surface. Mr. Lobdell, who had investigated this phenomenon, in his foundry at Wilmington, had succeeded in developing exactly similar internal flaws by a modified thermal test using ¼-in. instead of the usual 1½ ins. of hot metal, indicating that they were caused in service by the action of the brakes. Generally speaking, the wheel manufacturers and railway motive power men, whom he had recently visited seemed to feel that they were now out of the woods, that the cast-iron wheel as it is now being made promised to be satisfactory for 40 and 50-ton cars. They were not, however, quite sure that they yet wanted to make a cast-iron wheel which would stand under a 60-ton car.

Mr. Wm. McIntosh (C. R. R. of N. J.) thought that the breakage of cast-iron wheels were due chiefly first to their being overloaded and second to the fact that trains were handled over grades with hand brakes applied to a few wheels only of the train. Mr. Pemberton Smith (New York Car Wheel Works) described the metal used in the wheels made by that firm, and stated that they now stood ready to supply wheels for 50-ton cars and guarantee them against flange breakages. He thought that the securing of a cast-iron wheel suitable for 50-ton cars was simply a matter of using a heavier wheel of better material and paying more for it. The discussion was closed by a vote to continue the committee for another year.

OUTSIDE DIMENSIONS OF BOX CARS.—This report was presented in response to a request from the American Railway Association that the Master Car Builders Association decide on and adopt outside dimensions for box cars to correspond to the inside dimensions for such cars which had been adopted as standard by the American Railway Association. The recommendations of the report were as follows:

(1) That the inside dimensions of box cars as approved by the American Railway Association, namely, 36 ft. long, 8 ft. 6 ins. wide and 8 ft. high be submitted to letter ballot for adoption as standard.

(2) For box cars on high trucks (4 ft. to top of floor):

| | Ft. | Ins. |
|---|---|---|
| Height, top of rail to upper edge of eaves..... | 12 | 6¾ |
| Width at eaves, at above height, maximum.... | 9 | 7 |

be submitted to letter ballot for adoption as standard.

(3) For box cars on low trucks (3 ft. 6 ins.):

| | Ft. | Ins. |
|---|---|---|
| Height, top of rail to upper edge of eaves..... | 12 | ¾ |
| Width at eaves, at above height, maximum.... | 9 | 7 |

be submitted to letter ballot for adoption as standard.

(4) That the words and letters "Standard 12 ft. 6¾ in. by 9 ft. 7 in." be stenciled in 3-in. letters on the end fascia boards on all cars built to these dimensions.

The discussion referred chiefly to the neglect of the committee in not recommending a standard length and in dissenting from the decision of the American Railway Association to adopt a side door opening 6 ft. wide. It was the general opinion that the Master Car Builders' Association was not yet in a position to adopt a standard outside length for box cars. The discussion was closed by a vote to continue the committee with instructions to design a system of framing above the floor for box cars having the dimensions recommended in the report.

STANDARD PIPE UNIONS.—This report was the same as that presented by the committee of the American Society of Mechanical Engineers at the Boston meeting last month.

The fact was brought out in the discussion of the Mechanical Engineers' committee had not had great success in securing the co-operation of the manufacturers in their labors, and in view of this it was voted that the Master Car Builders' committee be continued another year with instructions to confer with the manufacturers of pipe unions and secure their co-operation.

ELECTION OF OFFICERS.—The following officers were elected for the ensuing year. President, J. W. Marden (B. & M.); First Vice-President, F. W. Brazier (N. Y. C. & H. R.); Second Vice-President, W. P. Appleby (D. L. & W., N. H. & H.; Third Vice-President, Joseph Hill (M. C. Cent.); Treasurer, John Kirby (L. S. & M. S.); Secretary, J. W. Taylor; Executive Committee, L. T. Reynold (D. L. & W.); H. F. Ball (L. S. & M. S.), and F. H. Prince, Jr. (P. & R.).

## NOON-HOUR DISCUSSIONS.

The practice of the Association to devote one session of each session to topical discussion resulted this year as it had in the past, in developing some of the most interesting technical work of the convention. These discussions, although they occurred at different times, are for convenience given together in this report of the convention proceedings as follows:

METAL CENTER SILLS IN WOODEN CARS.—This discussion was opened by Mr. R. P. C. Sanderson (Big Four-board Air Line) with the statement that he considered the use of steel center sills in connection with wooden intermediate and side sills a serious mistake. His reason for this belief was based upon the fact that the deflection of the steel sill was always less than that of the wooden sill. As a result it was only a question of time when the permanent set or deflection of the wooden sills under repeated loads threw the bulk of the work on the steel sill and it failed. Mr. Charles Streicher (C. R. R. of N. J.) agreed with Mr. Sanderson and instanced the fact that the "sandwich" bolster of combined metal and wood, which was introduced a number of years ago, had proved a failure owing to the shrinking of the timber, and the breaking of the connecting bolts, which finally threw all the load on the metal parts of the bolster. He thought that the time was past for figuring on combined wood and steel construction for cars, and that the duty of master car builders was to devote their thoughts and labors to developing an all-steel car construction. Mr. J. E. Simons (Pitts. Coal Co.) was opposed to the combined steel and wood in car construction for the reason that the wood shrunk and the steel did not, that it was impossible to join steel and wood so that moisture would not collect in the joint and cause rust and rot, and that under the buffing strains the bolt holes wore oblong in the wood and did not in the steel, thus causing loose and broken bolts. He considered that the time had gone by when the wooden draft timber should be used, and in the construction of new cars he would certainly advocate an all-steel underframing.

METERS FOR STOPPING LEAKS IN RAILWAY EXPENSES.—The purpose of this discussion, which was opened by Mr. G. W. Rhodes (B. & M. R. R.), was to urge the necessity of attention to small wastes, he cited the lighting of headlights and coach lamps some hours before darkness to save trouble. The meter for these and similar wastes was a system of carefully kept itemized accounts. In the discussion which followed the importance of correcting the small wastes mentioned by Mr. Rhodes was generally conceded, but beyond the general statement that such wastes should be followed up and stopped by keeping accounts and formulating and enforcing rules, this discussion brought out few facts of importance.

MAINTENANCE OF STEEL CARS.—The discussion of this subject was opened by Mr. W. H. Lewis. He considered that the problem of maintaining steel cars was not essentially different from that of maintaining locomotives. Steel cars had not been in use long enough for the railways to have had any experience in their maintenance due to age and natural depreciation. So far all repairs had been those made necessary by wrecks. Prior to 1898 there were no steel cars to speak of. In 1897 the Schoen Pressed Steel Co. turned out 501 cars, and the total number of cars manufactured by that firm and its successor, the Pressed Steel Car Co., up to June 1, 1902, was 63,872. Counting in the steel cars made by others, there were now in service perhaps 70,000 of such cars. This was less than one-half of 1% of the total number of cars in service in the United States. There was, therefore, not enough of such equipment, and it had not been in use long enough to permit railway companies to formulate rules and to provide facilities for its systematic repair and maintenance. They were repairing steel cars with practically the same workmen and tools and plant that they used for repairing wooden cars. He knew of no special tools or facilities actually in use for maintaining steel cars. As their number increased, however, special tools and plant would have to be provided, and now was the time to have the matter in mind. The dis-

was continued by Mr. F. H. Stark (B. & O.) and Mr. McIntosh (C. R. R. of N. J.), who repeated and reiterated the statements of Mr. Lewis.

METHODS OF CAR LIGHTING.—This subject was introduced by Mr. L. T. Canfield (D., L. & W.), as follows:

During the last few years a new kind of gas has come into the field as an illuminant—acetylene. Cars equipped with it have burners that consume ½ cu. ft. of gas per hour and give a light of 35 c. p., while the Pintsch gas burner that consumes about 2 cu. ft. of gas per hour and give a light of 25 c. p. We have several different systems of furnishing acetylene gas for car lighting, some of which generate the gas from a generator attached to each car; others have a generating plant similar to the Pintsch gas plants, where the gas is generated and compressed to as high as 300 lbs. per sq. in. The method of storing acetylene gas was discovered by two French inventors, who found that one volume of acetone at ordinary temperature and pressure dissolved 25 volumes of acetylene and under 12 atmospheres of pressure would dissolve 300 volumes of acetylene.

The reservoir for storing this gas the porous bricks, or asbestos, which is sometimes used, is simply for the prevention of explosion. The acetone is for the storing of gas in large quantities in small space, and these two do not enter into the quality or efficiency of the light. The bricks are first made of a mixture of clay and powdered charcoal. The baking of them burns out the charcoal, leaving a porous brick, with which the storage reservoirs are packed. If these bricks were pressed solid, allowing up the openings made by the burning out of the charcoal, the solid substance would take up 20% of the space within the reservoir; 43% of the reservoir would be filled with acetone, leaving 37% of the space for expansion. A reservoir 20 ins. in diameter by 10 ins. long filled as stated above, charged with acetylene gas at 165 lbs. per sq. in., was placed upon a car on the Delaware, Lackawanna & Western R. R., having four lamps with three burners each and one lamp with one burner. This gas burned a total of 260 consecutive hours and was in service from March 4, 1902, to May 12 of the same year without recharging. The fact of being able to run the car so long without recharging makes this a very desirable light.

Our patrons appear to be quite well pleased with acetylene light. The application of the same is very similar to the application of the Pintsch light and gives less trouble, from the fact that we do not have to fill the reservoirs as frequently. There is one thing, however, that is necessary, and that it, to have a successful light, the gas must be kept cool; consequently the pipe leading to the burner, instead of coming down through the center of the lamp, must be brought down on the outside, placing the burner on the end and above the pipe. I must say that cars equipped with this system are the best lighted we have.

I have had experience with none of the systems that have a generator on each car, and from what I can learn of it, I am very much in favor of the system where the gas is generated at a stationary plant, then stored in reservoirs on the cars. There is another system used largely in the Northwest, where the porous brick and acetone is not used, but a large number of reservoirs are used. I am advised that a car with two or three reservoirs has been known to furnish light for cars in a snow blockade for as long as 12 days. To overcome the explosive feature, this system uses fusible seams in tanks and all high pressure pipes under the car are of fusible material, which will fuse at or below 500° F. I have had no experience with this system.

There are, as you are aware, several systems of electric car lighting in this country, all of which have to a greater or less degree desirable features, also many undesirable ones. The three most important commercially are the storage battery, the electric motor driven by a steam engine, generally placed in the baggage car at the head end of the train, and the axle lighting device.

The first of these, while maintaining a steady light—that is, if provided with a sufficient capacity—is objectionable in its present form, on account of its excessive weight, its limited reserve capacity for unexpected delays or accidents, the necessary large proportion of time the car is kept out of service for recharging or the amount of labor required to change the batteries, and the limiting of the movement of cars so equipped to special runs.

The second, or steam-driven motor system, is also objectionable on account of the expense of operation, which includes, with the cost of the special engineer or electrician required, the cost of maintaining all necessary apparatus pertaining to the power plant and the excessive vibrations felt throughout the train when the engine is running the dynamo, the vibrations of the voltage at the lamps by the variations of the steam supply to the engine from the boiler of the locomotive, the danger of fire on account of the high voltage, also the limiting of movement of cars so equipped to special runs, which destroys the mobility of the railroad company's car equipment as a whole.

The third, or axle-lighting system, which in my mind is the best system in use to-day, on account of allowing of the free movement of cars, consists of a dynamo or generator driven by a pulley on the axle of the car and the storage battery working in combination with the dynamo, the dynamo charging the battery when the car is running, and the lights not burning, and working in series with the same when all the lights are burning. This system may be divided into two classes, one of which uses the so-called automatic regulator for maintaining the output of the dynamo constant by varying the strength of the field coils, thus keeping the voltage of the machine the same as that required by the lamp; but this regulator is such a delicate machine that the rough usage to which it is subjected in railway service puts it out of order very frequently. Besides, as far as I can learn, there has not as yet been made a perfect automatic regulating device for governing the flow or intensity of an electric current, and while they may be called automatic, and probably are automatic for a short time, they cannot be relied on. The other design depends upon the slipping of the belt on the pulley for maintaining the voltage of the dynamo constant, and as you all know, the varying changes of the atmospheric conditions will affect the belt, and at the best this is a very crude and unsatisfactory way of attaining the desired effect, it requiring constant attention, as it is not automatic.

In operating the axle lighting system, it is necessary to handle the same with a great deal of care. The batteries, for instance, must be charged immediately after they are set up, as the plates will rapidly deteriorate if they are left standing in the uncharged diluted sulphuric acid which is used. Again, you must not charge or discharge same too fast, for fear of buckling the plates, and when a new battery is placed in service it is necessary to charge and discharge it several times. If the battery is overcharged, charged or discharged too fast, it has the effect of sulphating the plates, which increases the internal resistance of the battery and also uses up these plates and destroys the battery much sooner than in ordinary use. I will not attempt to give a detailed description or try to explain the actual working of the electrical apparatus of these two different systems, as it would take up too much time, and in a general way they resemble each other; but will point out a few of the faults, showing what we have to contend with in trying to keep the lights burning when required. The dynamo does not become operative until the train has reached a certain speed, about 12 miles per hour, called the critical speed. In suburban service, for instance, if from any cause the batteries are run down—that is, nearly all of the stored electricity in them is used—you will not get the benefit of the dynamo in recharging them or helping to supply the light until the critical speed is reached, and in many cases about or before the time this speed is attained it is necessary to slow down the train for the next stop. Therefore, you are not generating any electricity, but your lights are burning all the time and using it continually from the storage battery, wherefore the lights grow dimmer and sometimes go out when the train is standing still, or is running below the critical speed. At this time of the year we naturally have very little trouble, but in the winter time, when the days are short, and it is necessary to use the light for a longer period of time it is different. On through service you will not, of course, have this particular trouble to contend with, but in the operating of this kind of light the belts occasionally jump off of the pulleys or break, the battery becomes defective, the regulators get out of order, the fuse burns out, there is a short circuit, a wire is broken, the armature burns out, the armature shaft breaks, the dynamo runs hot, the commutator is out of order, or something in the system gives out or goes wrong, and the lights become dim or go out altogether; then we are in trouble.

At the present stage of electric lighting in railway service it is absolutely necessary to have an auxiliary light at hand to fall back on. I am sure many of us who have had experience with this light would be perfectly satisfied to do away with it on account of the trouble it has caused; but this is an age of progress, and there is no doubt but that there will continually be improvements made in electric car lighting. When it is so perfected that it will not require an expense greatly in excess of that necessary to maintain the gas lamp of to-day, I am sure it will come into general use.

I will conclude by reading a statement comparing the cost to our company of each kind of light for one month.

First-Class Cars.

| Kind of light. | No. of lights. | Average mileage. | Cost per car. | Cost per flame. | Kind of service. |
|---|---|---|---|---|---|
| Oil ..... | 6 | 12,710 | $2.40 | $0.40 | Through |
| Electric lights.. | 17 | 2,092 | 8.81 | .52 | Suburban |
| Electric lights.. | 36 | 12,710 | 37.31 | 1.04 | Through |
| Electric lights.. | 25 | 1,560 | 7.57 | .30 | Suburban |
| Pintsch gas.... | 20 | 12,710 | 5.75 | .29 | Through |
| Pintsch gas.... | 16 | 2,092 | 2.45 | .15 | Suburban |

## THE NEW PITTSBURG PLANT OF THE AMERICAN BRIDGE CO., NEAR ECONOMY, PA.

The American Bridge Co. has acquired an extensive area of land on the Ohio River, near Economy Station, on the Pittsburg, Ft. Wayne & Chicago Ry. (Pennsylvania Lines West of Pittsburg) about 15 miles below Allegheny, Pa. The site comprises about 150 acres lying between the railway and the river and extending from Economy Station up to the Sewickley Creek. On this site a new bridge manufacturing plant is in process of construction. The company has also preempted an area of about 125 acres on the upper plateau above the railway and adjoining the village of the Harmony Society at Economy. This latter property is intended for a residence district. It is the intention of the company to concentrate at this point the older plants of the company in the Pittsburg district. The plant will be the most extensive of its kind in existence and will have a producing capacity of 15,000 to 20,000 tons per month of miscellaneous structural material. The buildings will all be substantial and permanent structures and all the appliances will be devised in accordance with the latest experience and arranged for the most economical handling and production of material. Reference to the accompanying plan which, with the following description, has been furnished us by the American Bridge Co., will indicate the general arrangements of the new shops.

### YARD TRACKS AND TRAVELING CRANES.

The shops are paralleled by a system of standard gage tracks which communicate with all the buildings and connect with the Pennsylvania Lines. A belt line of 3 ft. gage, to be operated electrically, also encircles the works for the convenient transportation of men and also of material in small bulk. Near the center will be situated the receiving stockyard of the establishment where all the mill material is received and distributed for its passage through the shops. This stockyard is covered by a system of traveling cranes extending from the railway towards the river and at right angles to the direction in which the material moves. At the delivering ends of the bridge shops similar cranes of greater capacity are located for handling and loading the finished product and at other points, as described on the plan, there will be located similar parallel systems of traveling cranes for the convenience of the contiguous shops. These cranes all have a uniform span of 60 ft. and are interchangeable on their respective runways. Toward the railway end they connect with a gantry which runs parallel with the railway, by means of which cranes can be transferred from one point to another as convenience requires or a special heavy crane can be placed on any runway to facilitate the handling of exceedingly heavy pieces.

### MAIN BRIDGE SHOP.

The main bridge shop will be a massive building 270 ft. wide by 780 ft. in length, equipped with tools and handling appliances of modern design. The whole area of this shop will be covered by a system of electric hoists operating transversely. At the lower or discharging end of the shop facilities are provided for handling and machining structural members of over 100 tons in weight or over 120 ft. in length. Many of the tools in this shop will be of special design, such as multiple punches for simultaneously punching standard beam connections, and punches with automatic tables or adjustable spacing racks. Multiple radial drills carried on longitudinal moving gantries will serve for the usual drilling and reaming. Riveters of special design will be carried on gantries or traveling wall-brackets. All revolving machinery will be electrically driven, no vertical belts being required, thus clearing the whole overhead area for the free use of the electric hoists.

This building is flanked with lateral wings which serve as tool rooms, shop offices for the foremen, etc. The building will be lighted by high sash around the walls in conjunction with an ample area of skylights in the roof. The general construction of this building and of all the shops of the plant will be a skeleton framework of steel, thoroughly braced, and having all wall surfaces not of glass, filled with cement concrete. The only combustible material used will be the wooden plank sheathing for the roof. Longitudinal narrow gage tracks at suitable intervals extend from the stockyard through the shop to the loading cranes, on which material will be carried by power operated trucks. Arrangements are made for heating the buildings in the winter season and other provisions are also made for the comfort and convenience of the workmen.

### AUXILIARY BRIDGE SHOP.

Paralleling the main bridge shop and between it and the river, space is reserved for the auxiliary bridge shop, the exact dimensions and character of which will be determined later on. This shop will be fitted up for the fabrication of special structural work such as highway bridges, roofs and material generally of a lighter or more complicated type than that handled in the main bridge shop. In works of this kind experience has demonstrated the desirability of separate shops for different classes of work, where the character of the tools and the operations to be performed on the material render it advisable to resort to different methods of treatment.

### TEMPLET SHOP.

Between these two structural shops will be located a templet shop, which will be a building about 60 ft. wide and 500 ft. long. This building will be provided with ample facilities for handling and finishing templet lumber and distributing it in the most convenient manner throughout the shop. This shop will be provided with longitudinal galleries along both sides, leaving a central opening to facilitate lighting and ventilating. The main floor of this shop is lifted sufficiently above the general level to permit the use of its basement for closets, lavatories, etc., for the workmen of the bridge shops. Lumber will all be stored in an outlying building at a distance to reduce fire risks, and the lumber will be delivered as required by means of the narrow gage track, heretofore described.

### POWER HOUSE.

In the up-river direction across the stockyard, the power house is established in a central location. The motive power for the present will be derived from steam boilers, although gas engines

have been considered and may possibly hereafter be adopted. The boilers to be installed at present are of the water tube type provided with automatic stokers and convenient facilities for handling fuel and ashes. At this point will be located all the engines required for the various purposes—direct connected electric generators, air compressors, hydraulic pressure pumps, and the pumps for the general water supply for the whole plant. River water will be drawn from wells located near the river's edge, which will be sunk into the gravel below the extreme water level, affording an ample supply of clean filtered water. This water is discharged into a storage tank situated near the power house, and thence distributed by the mains where required. In an emergency, such as an outbreak of fire, connection between the pumps and the tank can be closed, and the pumps are so designed as to deliver at high pressure into the mains for fire service. The steam engines of the power house will all be of the compound type, designed to work under an initial pressure of 150 lbs. and to operate condensing.

### EYE-BAR SHOP.

Above the power house is situated the hydraulic forge for eye-bars. This shop will shortly be in operation. It will contain two separate systems of hydraulic forging machinery, one set for finishing bars up to and including 8-in. widths. The other set will handle bars up to 16 ins. in width, with heads 36 ins. in diameter. This latter system, which is now nearly completed, will be the most powerful of its class in existence. The main upsetting machine will weigh 250 tons, almost entirely of steel, and will be capable of exerting an upsetting pressure on the eye-bar of 1,500 tons and a simultaneous vertical holding down pressure on the bar of 3,000 tons. The hydraulic shears will be capable of cutting cold bars of 16 × 3 ins., with a shearing pressure of 1,600 tons and the vertical punch capable of punching 16-in. holes through 3-in. material, hot, and exerting a pressure of 1,000 tons. Suitable rolling and straightening machines will be installed. Roller straightening is intended, as far as possible, to reduce the liability of injury to the bars. All the furnaces will be heated either by oil or natural gas. The annealing furnaces are designed for continuous production and will be so controlled as to heat the material to the desired refining temperature. All this hydraulic machinery, as well as similar machinery, in other parts of the establishment, will be supplied with water from the power house under a fixed pressure 6,000 lbs. per sq. in. and each machine will be supplied with suitable intensifiers to raise this initial pressure to whatever may be desired. In some cases this will be over 6,000 lbs. per sq. in. The eye-bar shop will be traversed by electric traveling cranes for handling and distributing the material throughout the entire area of the shop.

### BENDING AND FORGE SHOP.

The bending and forge shop is situated next to the stockyard and on the line of the main bridge shop. This building contains the various forging tools of the establishment and also an equipment of tools for bending and curving. Its situation is a convenient one for receiving its material from the stockyard and delivering it to the bridge shops. Immediately above the latter shop is located a building of similar design and dimensions to that just described, which contains all the machinery for producing the rivets, bolts and nuts of the establishment. It will have sufficient capacity to deliver about 1,000 tons of rivets and bolts per month. This building will contain the stock of manufactured bolts and rivets which can be readily transferred to any part of the plant by means of the narrow gage service track. Still further up river, as shown by the plan, are located the machine shop, pattern shop, iron foundry, and testing laboratory.

### IRON FOUNDRY AND STEEL FOUNDRY.

The areas at the ends of these buildings and also the shops contiguous to it are covered by electric traveling cranes. These cranes are of the same span and height as those which serve the bridge shops and at the railway end they terminate and connect with the same transferring gantry so that cranes throughout the whole length of the works can be transferred from one runway to the other as desired.

In the shops the electric current from the central power station will be transformed by a multiple voltage system, so that currents of different potentials can be led to the tools and utilized for speed regulation. The motors on all principal tools will be directly attached to the tool, thus avoiding the interposition of belts and countershafts; leaving the overhead space all clear for handling appliances to serve the tools. The system of electric trolley service will be extended over the whole shop area, so that all tools where the magnitude of the work requires it will be served with power handling devices.

The central avenue of the shop will be covered by a double system of runways one above the other, the lower runways carrying a clear span crane and those above carrying two shorter cranes; a longitudinal girder being provided in the center of the shop for supporting the interior ends of the latter cranes. This shop will be provided with a full complement of tools, among which will be several special machines, for the convenient handling of turntables and bridge work.

The pattern shop which will be situated between the machine shop and foundry will be equipped with the most modern and convenient appliances for this branch of the business, and the building will have a basement similar to that previously described for the templet shop, containing closets and lavatory arrangements for the workmen in the neighboring shops.

The iron foundry will be a building of the same dimensions and general style as the machine shop. It will contain the same general arrangement of longitudinal traveling cranes, and, in addition, it will be equipped with a system of traveling radial cranes for the convenience of individual operations. The cupolas will be served with convenient hoisting and charging machines for handling the stock. Natural gas will be used throughout the foundry for core baking and mold drying.

The steel foundry is not yet sufficiently developed to describe, but as the use of steel castings is rapidly extending, it will be necessary to have at least as large a foundry for these as for iron castings.

### TESTING LABORATORY.

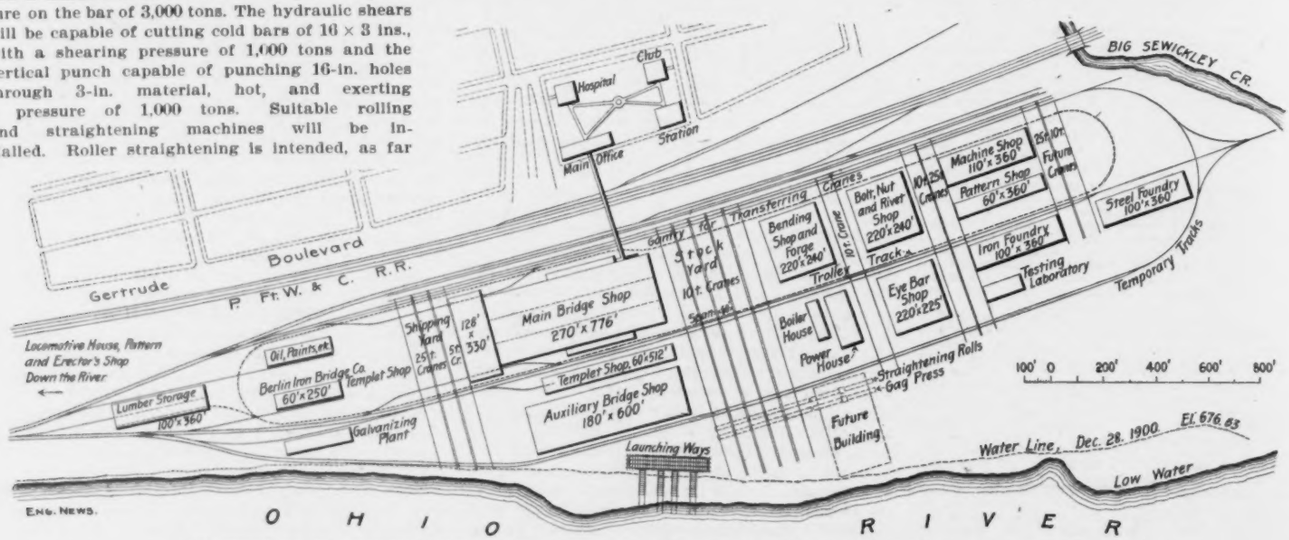
The testing laboratory in addition to the machines for tensile tests of steel specimens will contain an equipment for testing cement, concrete and other building materials, and also a powerful machine for testing to destruction the largest eye-bars. It is contemplated to install in this department convenient appliances for the information of the inspection department, so that the influences to which material is subjected in heating or in other shop treatment, may be observed.

### MISCELLANEOUS STRUCTURES.

As accessories to the plant but somewhat remote from the area for manufacturing there will be located suitable buildings for general storage supplies and to keep stores of lumber and patterns, erector's tools and material at a reasonably safe distance from the manufacturing plant.

On the opposite side of the railroad from the works about twenty feet above the railroad level is an extensive plateau which is well adapted by natural conditions for the residence district. This plateau extends several miles along the river embracing the lands and village of the Harmony Society and affords sufficient area for the comfortable reception of an extensive population. The main office of the establishment will be located on this upper level next to the railroad company's property and opposite to the center of the works with which it will be connected by an over-grade bridge for pedestrians; so that connection between the works and main office to the town can be maintained without crossing the railway tracks at grade. This office is not yet completely designed, and a building for temporary office purposes is being fitted for immediate use. It is the intention, however, to make this main office such as to afford the most convenient facilities and ample provisions for the officials of the manufacturing plant. The dimensions of the required office can be indicated from the estimate, that the drawing room alone must be of sufficient area to accommodate about 500 draftsmen. Ample land area is reserved for the manufacture of steel barges and similar river craft, which promises to be a large future industry.

The construction of these works is now in progress and it is expected that the plant will be sufficiently advanced to permit manufacturing operations to begin during the coming year.




GENERAL PLAN OF THE NEW PITTSBURG PLANT OF THE AMERICAN BRIDGE CO., NEAR ECONOMY, PA.